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Station #12

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ENGINEERING DATA TRANSMITTAL

Page 1 of 1

1. EDT 602518

2. To: (Receiving Organization) Distribution	3. From: (Originating Organization) Env. Eng. Support	4. Related EDT No.: NA
5. Proj./Prog./Dept./Div.: 300-FF-1 Treatability	6. Cog. Engr.: J. G. Field	7. Purchase Order No.: NA
8. Originator Remarks: Please sign for approval		9. Equip./Component No.: NA
		10. System/Bldg./Facility: NA
11. Receiver Remarks:		12. Major Assm. Dwg. No.: NA
		13. Permit/Permit Application No.: NA
		14. Required Response Date: February 18, 1994

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15. DATA TRANSMITTED

(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	(F) Impact Level	(G) Reason for Transmittal	(H) Originator Disposition	(I) Receiver Disposition
1	WHC-SD-EN-TI-214		0	SEDIMENT AND PROCESS WATER CHARACTERIZATION IN SUPPORT OF 300 AREA NORTH PROCESS POND PHYSICAL SOIL WASHING TEST	4	1	1	

16. KEY

Impact Level (F)	Reason for Transmittal (G)	Disposition (H) & (I)
1, 2, 3, or 4 (see MRP 5.43)	1. Approval 2. Release 3. Information 4. Review 5. Post-Review 6. Dist. (Receipt Acknow. Required)	1. Approved 2. Approved w/comment 3. Disapproved w/comment 4. Reviewed no/comment 5. Reviewed w/comment 6. Receipt acknowledged

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1	1	Cog.Eng. J. G. Field	J G Field	2/14/94	H6-05	R. D. Belden			H6-05	3	
1	1	Cog. Mgr. J. G. Woolard	R.D. Belden for	2/14/94	H6-05	J. R. Freeman-Pollard			H6-03	3	
3		QA T. L. Bennington			H4-16	Central Files (2)			L8-04	3	
		Safety				EPIC (~~8~~) (1)			H6-08	3	
		Env.				ERC			H6-07	3	
						IRA (2)			H4-17	3	

18.	19.	20.	21. DOE APPROVAL (if required)
J G Field 2/14/94 Signature of EDT Originator Date	Authorized Representative Date for Receiving Organization	R.D. Belden for J.G. Woolard 2/14/94 Cognizant/Project Engineer's Manager Date	Ltr. No. [] Approved [] Approved w/comments [] Disapproved w/comments

BD-7400-172-2 (07/91) GEF097

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Title	Unclassified Category	Impact Level
Sediment and Process Water Characterization in Support of 300 Area North Process Pond Physical Soil Washing Test	UC-630	4

New or novel (patentable) subject matter? [X] No [] Yes
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SUPPORTING DOCUMENT	1. Total Pages ~~192~~ 147

2. Title	3. Number	4. Rev No.
Sediment and Process Water Characterization in Support of 300 Area North Process Pond Physical Soil Washing Test	WHC-SD-EN-TI-214	0

5. Key Words	6. Author
300-FF-1, treatability, CERCLA, physical separation, laboratory screening, wet sieving & analysis, attrition scrubbing APPROVED FOR PUBLIC RELEASE 12/13/93 D. Solis	Name: J. G. Field J. G. Field Signature Organization/Charge Code 81340/P215A

7. Abstract

WHC 1993, *Sediment and Process Water Characterizaation in Support of 300 Area North Process Pond Physical Soil Washing Test*, WHC-SD-EN-TI-214, Rev. 0, Prepared by R. J. Serne, S. V. Mattigod, V. L. LeGore, D. S. Burke, and T. L. Gervais, Pacific Northwest Laboratory for Westinghouse Hanford Company, Richland, Washington.

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9. Impact Level 4

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INTRODUCTION

The sediments in the 300 Area North Process Pond are being considered for clean-up using soil washing processes. Prior to site clean-up several preliminary pilot-scale (10 metric ton) physical washing campaigns were performed by Westinghouse Hanford Company (WHC) staff in the summer of 1993. WHC used equipment that was obtained from the U.S. Environmental Protection Agency. Specific details are found in the 300-FF-1 Physical Separations CERCLA Treatability Test Plan (DOE 1993). Physical soil washing includes separation and proper containment of the contaminant-rich fines and residual liquid effluent (if it should be deemed potentially hazardous) and release of the coarse "clean" fraction, should it meet minimum performance levels for residual contaminant concentration (see DOE 1992 for specific values) to the site being cleaned. A goal of the demonstration is to concentrate the contaminants into ≤10% of the soil volume excavated and, therefore, to release ≥90% of the soil back to the site as clean soil. To support interpretation of the WHC soil washing treatability study, PNL performed some sediment and process water characterization on samples taken during three major and one small campaign. This report documents particle-size distributions in various field washed piles, and chemical and gamma emitting radionuclide contents as a function of particle-size distribution for the field washed sediments and contents in the spent process water. All of the particle fractions were separated by wet sieving, but two field samples were also subjected to dry sieving and attrition scrubbing followed by wet sieving.

There have been several earlier studies that describe the history of the Process Ponds (Young, Fruland and Fruchter 1990; Young and Fruchter 1991), past sediment characterization (Dennison, Sherwood and Young 1989; Gerber et al. 1991) and the proposed soil washing treatability plan (DOE 1993).

The North Process Pond (~10 acres) was constructed in late 1948 to function as a percolation pond for fuels fabrication liquid wastes. The liquid wastes contained sodium aluminate from decladding the Al metal container around the uranium fuel. Later Zircaloy-2, a zirconium-beryllium based clad, was used. Thus, the waste stream likely contained Zr and Be in later years. Part of the fuel canning process also entailed use of tin and bronze (Cu). Mineral acids HF, HNO_3, and H_2SO_4, caustic (NaOH), and organic solvents and degreasers also ended up in the waste stream.

Radionuclides that were present in the liquid waste streams included uranium (natural with 0.7% ^{235}U, enriched to 0.95% ^{235}U and enriched to 1.25% ^{235}U) and small quantities of activation products (^{65}Zn, ^{59}Fe and ^{60}Co) from reprocessing fuel elements that had lost their seals.

SCOPE

The original PNL Scope included wet sieving 12 sediment samples received in a field-washed moist state within 5-gal or 1-gal paint cans or large plastic carboys depending upon the projected sediment particle size. The samples included feed sediment, >6 in. material rejected from the grizzly, <6- to >1-in. material rejected from the first vibrating screen, <1-in. to >2-mm over-sized material rejected from the trommel, <2- to >0.45-mm material rejected by the second vibrating screen and <0.425-mm material in a slurry with spent process water. Figure 1 taken from DOE (1993) shows the soil washing scheme. As designed, two tests were to be performed with a changing of screen sizes for the second vibrating screen. During testing it was decided to keep using the 0.425-mm screen instead of switching to the smaller 0.210-mm screen.

The first campaign was performed on June 23, 1993; the second campaign was performed on June 24th. A third small run of less than 1 in. material was processed through the trommel and second vibrating screen on June 25, 1993. Field samples from the third run were collected on July 9th. A fourth large campaign was performed September 8-9, 1993.

All the samples were to be wet sieved through a stack of sieves as shown in Table 1. In most cases the total sample volume (1 to 5 gal) was sieved. In a few instances for the finer-sized samples only a representative fraction of the total sample was sieved.

After sieving and drying, all of the oven-dried material from the various piles (see Figure 1) within a set size range for test campaign 1 were mixed and homogenized. Similar mixing and homogenization was performed on test campaign 2 and campaign 4 material. Aliquots of the homogenized size fractions were packaged and gamma rays counted to measure ^{238}U, ^{235}U, ^{60}Co and ^{137}Cs activities. Similar aliquots of the <9.5-mm and smaller size fractions were analyzed for metals, including uranium, by x-ray fluorescence.

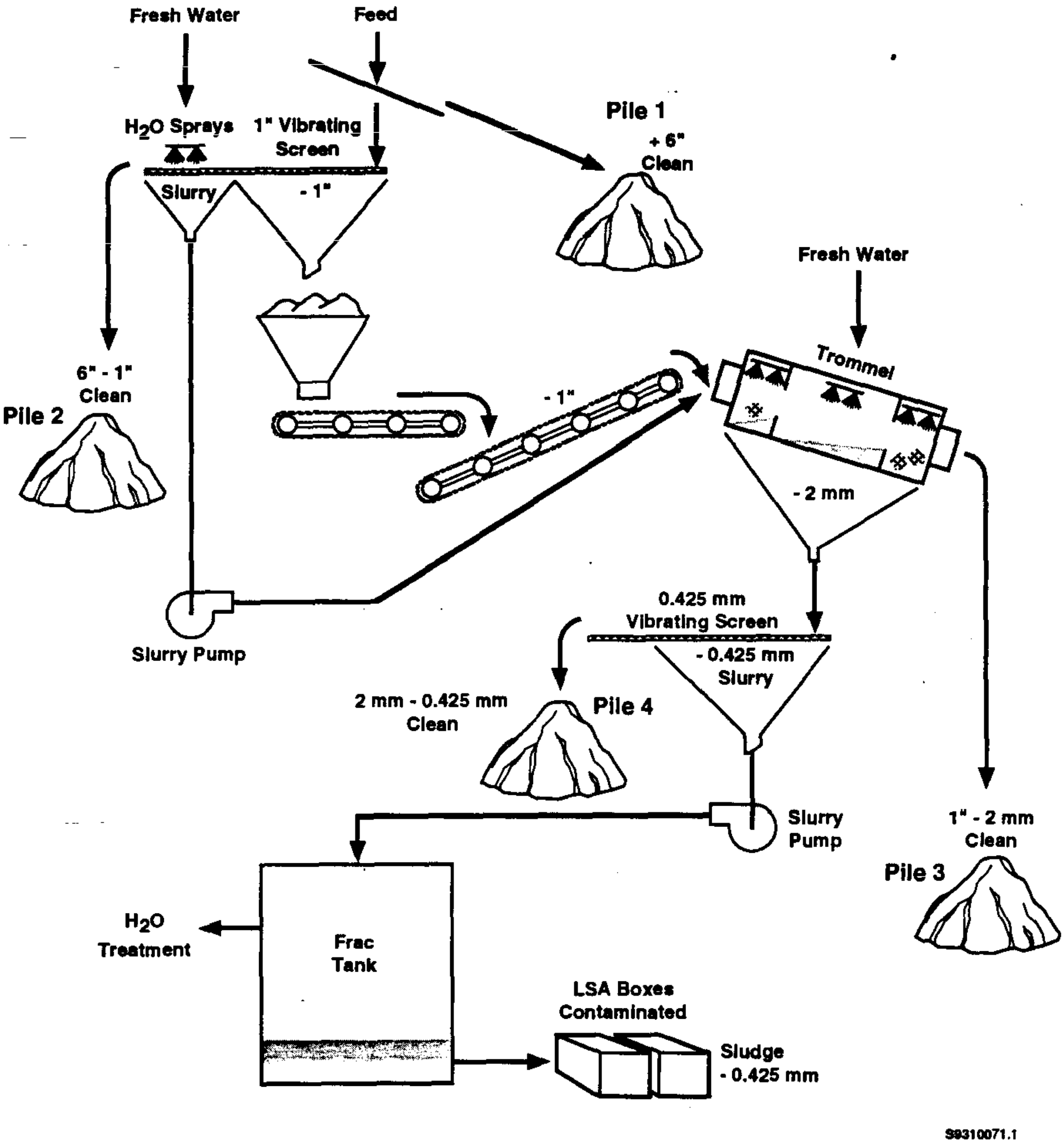

Figure 1. Modified EPA Soil Washing System (after DOE 1993)

TABLE 1. Sieves Used in This Study

Sieve Designation	Nominal Opening
50.0 mm or 2 in.	2 in.
25.0 mm or 1 in.	1 in.
12.5 mm or 1/2 in.	0.5 in.
9.5 mm or 3/8 in.	9.5 mm
#10	2.0 mm
#18	1.0 mm
#40	0.425 mm
#70	0.212 mm
#100	0.150 mm
#200	0.075 mm
0.45-μm filter	0.00045 mm

An aliquot of water from the <0.425-mm slurries from campaigns 1, 2 and 4 was filtered through 0.45-μm membranes and complete chemical analyses performed to provide data to water treatment engineers. An aliquot of the water generated during each sample's laboratory wet sieving was also analyzed by ICP-MS for U and selected trace elements for comparison to field process water and to allow complete activity balances to be performed.

During testing of campaign 1 and 2 samples, it became apparent that distinct agglomerates of material with either greenish or whitish hues were present in the coarser size fractions, >2 mm to <9.5 mm and >1 mm to <2 mm. These agglomerates survived both field soil washing and laboratory wet sieving and appeared to be enriched in radioactivity. Discrete specimens were handpicked from the homogenized size splits from campaigns 1 and 2 and separated by size and color. Portions of this material were gamma counted, submitted for complete chemical analyses and characterized by x-ray diffraction, optical and scanning electron microscopy to elucidate their identity.

SAMPLES RECEIVED

A total of 19 sediment (including 2 sediment-spent process water slurries) and 1 filtered spent process water samples were shipped to PNL directly from the 300 Area North Process Pond field test site by WHC. Six samples each represent the various streams shown on Figure 1 for campaigns 1 and 2. Two samples represent the <1-in. to >2-mm and <2-mm to >0.425-mm samples from a third small processing performed two weeks after the main washing tests. For campaign 4, 5 samples were received. A >6-in. sample was not sent. Table 2 gives some general information on the 19 samples. More details and a description of the mass of material subjected to the various tests are presented in Appendix A. The Hanford Environmental Information System (HEIS) numbers are presented in Table 2.

TABLE 2. Sample Description

Campaign	HEIS #	Description	Date Sampled	Size
1	B08MN6	Batch #1 Feed	June 23, 1993	5 gallon
1	B08MN8	Batch #1 >6-in.	June 23, 1993	5 gallon
1	B08MN9	Batch #1 6-in. to 1-in.	June 23, 1993	5 gallon
1	B08MP0	Batch #1 1-in. to 2 mm	June 23, 1993	1 gallon
1	B08MP1	Batch #1 2 mm to 0.425 mm	June 23, 1993	1 gallon
1	B08MN7	Batch #1 <0.425 mm slurry	June 23, 1993	carboy
2	B08NM2	Batch #2 Feed	June 24, 1993	5 gallon
2	B08NM4	Batch #2 >6-in.	June 24, 1993	5 gallon
2	B08NM5	Batch #2 6-in. to 1-in.	June 24, 1993	5 gallon
2	B08NM6	Batch #2 1-in. to 2 mm	June 24, 1993	1 gallon
2	B08NM7	Batch #2 2 mm to 0.425 mm	June 24, 1993	1 gallon
2	B08NM3	Batch #2 <0.425 mm slurry	June 25, 1993	carboy
3	B08NM8	Batch #3 1-in. to 2 mm	July 9, 1993	1 gallon
3	B08NM9	Batch #3 2 mm to 0.425 mm	July 9, 1993	1 gallon
4	B09758	Batch #4 Feed	Sept. 8, 1993	5 gallon
4	B09761	Batch #4 6-in. to 1-in.	Sept. 8, 1993	5 gallon
4	B09762	Batch #4 1-in. to 2 mm	Sept. 8, 1993	1 gallon
4	B09763	Batch #4 2 to 0.425 mm	Sept. 8, 1993	1 gallon
4	B09759	Batch #4 <0.425 mm slurry	Sept. 9, 1993	1 gallon
4	B09760	Batch #4 slurry water	Sept. 9, 1993	1 liter

METHODS

The sample containers were weighed on receipt on an industrial scale to the nearest gram. The containers were then opened and the volume occupied by the sample estimated to the nearest 1/8th of a container. The samples (excluding the three slurries) were individually removed from the containers and mixed within their plastic bags for about 1 min. Three small aliquots of material (~10 to 300 g) were removed from the plastic bag and moisture contents determined by oven drying to a constant weight at 105°C. Next a small aliquot (20 to 100 g) of wet material was dried and archived as a representative of the as collected sample.

Finally, the entire contents of the remaining sample or a representative aliquot was wet sieved as described below. Two samples, B08MP1 and B08NM7, were split into three aliquots after moisture content and archive samples were removed. One aliquot was wet sieved the same as most other samples. One aliquot was dried in an oven at 105°C and then dry sieved and the final aliquot was subjected to attrition scrubbing followed by the traditional wet sieving.

For the two slurry samples, B08MN7 and B08NM3, excess solution was decanted out of the carboy. The carboy was shaken vigorously and the slurry poured into a plastic tub. Water previously decanted was used to remove solids stuck to the carboy. The slurry in the tub was well mixed then moisture content samples and an aliquot for wet sieving was removed. Remaining moist sediment was stored in double plastic bags. The fine sediment from the fourth campaign's <0.425-mm slurry, B09759, was separated from excess solution in the field and sent in a 1-gal can.

The wet sieve procedure includes the use of a commercially available Gilson Model WV-3 Wet-Vac Sieve Shaker that was modified to allow once through circulation of wash water and removal of a filter apparatus in the pump system. The apparatus consists of a water tight enclosure around a rack that holds the sieves. The rack can be vibrated to facilitate particle sorting. A spray nozzle right above the top sieve vigorously wets the sediment and the water is collected in a reservoir below the bottom sieve. A pump attached to a reservoir of deionized water circulates the water through the spray nozzle during the sieving process. In general it took about four times the sediment weight of water to adequately separate the various particle sizes in the instrument.

The coarse samples containing particles predominately greater than 1 in. were hand washed using a wire brush. Large rocks (>2 in.) were removed, dried and weighed. The remaining material was sieved through a stack of sieves (2 in., 1 in., 0.5 in. and 9.5 mm). Fines and wash liquid was collected in a carboy. Material in the carboy was then wet sieved in the Gilson Wet Vac apparatus.

For the predominately finer grained samples (<9.5-mm) the automated wet siever was used directly. An aliquot of sample that just covers the cross section of the top sieve is placed on the top sieve. The stack of sieves from bottom to top was 0.075, 0.150, 0.212, 0.425, 1.0 and 2.0 mm. The plastic cover is clamped in place and the water spray/vibrator started. After several minutes the Wet Vac was stopped and the top (coarse) sieve inspected. If it appeared that no fine material was stuck on the sieve, the sieve was removed for drying. The next sieve was inspected and if there were fines still held on the sieve, the Wet Vac was restarted for a few minutes. The visual inspections were repeated until all sieves appeared to retain only appropriate material. A rubber policeman and squirt bottle were used to rearrange particles on each sieve to visually assure complete sieving. Once the material on each sieve appeared appropriate, excess water is removed into the next smaller sieve by tapping. The "dewatered" sieve was placed on top of a pan and oven dried.

The wet-sieving process was repeated with another batch of soil and sieves or until all material was sieved. At the end of sieving the <0.075-mm fraction in the fines reservoir was poured into drying pans and oven dried. All dried material on sieves and slurry pans was scraped into appropriately marked containers.

Two aliquots from samples B08MP1 and B08NM7 were also dried sieved. The process consisted of using an automatic CSC Scientific Company, Inc. Sieve Shaker #18480 inside a fume hood. The stack of sieves included from bottom to top: catch pan, 0.075, 0.150, 0.212, 0.425, 1.0 and 2.0 mm. About 100 g of dry material was placed on the top sieve, covered and shaken at maximum force for 10 min. Each sieve was then inspected by tapping the top sieve and manipulating particles with a rubber policeman. When less than 1% of the mass passed through to the next smaller sieve, the sieving was considered complete. The dried size fractions were placed in appropriate containers and the weights were recorded.

Two aliquots from samples B08MP1 and B08NM7 were also pretreated by attrition scrubbing [Cole-Palmer Servodyne Mixer Controller Model 50000-20] and then subjected to wet sieving. A moist homogenized aliquot that represents 500 g on a dry basis was wetted with water to a consistency of 83% by weight solids. The wet sample was then scrubbed for 30 min with the dual rotating blades revolving at 900 rpm. These conditions were found to be most effective in removing contaminants from >0.250-mm particulates for other Hanford sediments. After the 30-min attrition treatment the samples were wet sieved in the Gilson Wet Vac. Differences between the particle size distribution and contamination levels before and after attrition scrubbing are discussed in the results section.

Samples of the process water removed from the slurry samples, B08MN7, B08NM3 and B09759, were filtered through 0.45-μm Millipore HA membranes and filtrate aliquots distributed to various PNL labs for complete chemical analysis. The solutions from B08MN7 and B08NM3 were separated from the sediment approximately 1 month after the field testing. For slurry sample B09759, the solution was prefiltered in the field and further filtered through a 0.45-μm Millipore HA membrane 1 hour after receipt on September 10, 1993. Aliquots were analyzed by ICP to measure major cations, IC to measure selected anions, ICP-MS to measure ^{238}U and ^{235}U and selected trace metals and total carbon analyzer to measure total and organic carbon. The pH was also measured.

Aliquots of the wash solution from the laboratory wet sieving in the wet-vac were also submitted for ICP-MS measurements of ^{238}U, ^{235}U and selected trace metals.

ANALYTICAL DETAILS

The sized samples <9.5 mm were analyzed for metals content by x-ray fluorescence. Approximately 1 g of each size was ground to less than 50 µm using a mortar and pestle. The ground powders were mounted on slides and held in place by stretched para-film. Four x-ray excitation sources were used sequentially to gather data on elements as light as Al and as heavy as U. Appendix B contains the complete set of data.

Gamma-ray analyses were performed on size separates smaller than 3 in. Larger material, >2-in. rocks, were individually wrapped in Saran wrap and placed directly on the detectors. For each soil washing campaign only one or two of these large rocks were randomly selected and counted. We have no established standard counting geometries for such samples such that the quantities reported in Tables 9, 11, and 13 for samples >2 in. should be considered as estimates. For moderate sized particles (<2 in. to >2 mm) 4-ounce tin cans (6.1 cm dia x 4.6 cm height) were filled to a specified depth for which we have standard counting efficiencies calculated. The specific weights of each sample used to fill the prescribed volume of tin can was measured for each sample. For finer grained samples (<2 mm) the standard counting geometry was to place up to 5 g into a plastic liquid scintillation vial with a nominal volume of 20 ml (2.54 cm dia x 5.1 cm length) for which we have standardized counting information.

Because of sample size limitations the discreet green and white hued specimens were counted in the 5-g standard geometry instead of the larger tin cans.

RESULTS

Moisture Contents and Bulk Density

Table 3 lists the percent moisture contents of the as received samples. The moisture content of the <0.425-mm slurry samples for campaigns 1 and 2 is not of interest, because excess water was decanted prior to analysis. The parameter of interest is grams of dry solid/liter of wash water. For campaign 4 the solids and spent process water were separated in the field and no value was obtained for the solids to water content. The values shown in Table 3 were calculated from the raw data shown in Appendix A.

The dry bulk density calculations were biased low likely because the plastic bags inside the containers do not allow the metal containers to completely fill up to the point at which the bag in the container was filled. The dry bulk density values thus are not reported and should not be used to estimate the weight of material in each pile in the field. For campaign 4 bulk density calculations were not attempted based on the marginal results in campaigns 1 and 2. Estimates of dry bulk densities for each pile are given in the Conclusions and Recommendations section based on expert judgement.

The moisture content data for coarse material (greater than 1-in.) are low and quite variable. The sample from campaign 3, B08NM8, was notably drier than similar material from the other campaigns because there was a 14-day delay in procuring the sample after field treatment. The feed material from campaign 4 was much drier than feed materials from campaigns 1 and 2. The slurry (<0.425 mm) sample from campaign 2 contained 3.6 times as many solids as campaign 1, suggesting more efficient usage of process water in campaign 2. Moisture content data are also dependent on the length of time between processing and sample collection because sands drain quite rapidly. Perhaps exact times of sampling versus soil washing activities are available in the field log book. This type of data should be considered prior to making any conclusions on water usage and efficiency based on measured moisture contents.

TABLE 3. Moisture Contents for As-Received Field Samples

Sample	Moisture Content %
Campaign 1	
B08MN6 Feed	25.10 ± 4.02
B08MN8 >6 in.	Not Done
B08MN9 6 to 1 in.	0.81 ± 0.59
B08MP0 1 in. to 2 mm	3.22 ± 0.97
B08MP1 2 to 0.425 mm	18.16 ± 0.15
B08MN7 <0.425 mm	33.50 ± 0.18
Solids Content in Slurry	277 g/l
Campaign 2	
B08NM2 Feed	27.22 ± 5.31
B08NM4 >6 in.	0.68 ± 0.12
B08NM5 6 to 1 in.	2.35 ± 2.38
B08NM6 1 in. to 2 mm	8.75 ± 4.24
B08NM7 2 to 0.425 mm	21.48 ± 0.50
B08NM3 <0.425 mm	24.56 ± 1.02
Solids Content in Slurry	990 g/l
Campaign 3	
B08NM8 1 in. to 2 mm	0.81 ± 0.11
B08NM9 2 to 0.425 mm	16.08 ± 0.12
Campaign 4	
B09758 Feed	1.04 ± 0.43
B09761 6 to 1 in.	0.55 ± 0.54
B09762 1 in. to 2 mm	2.64 ± 0.72
B09763 2 to 0.425 mm	10.68 ± 0.59
B09759 <0.425 mm	35.45 ± 20.95
Solids Content in Slurry	Not available. Sample was prefiltered in field

Particle Size Distributions

Tables 4, 5, and 6 present all the sieving results for campaigns 1, 2, and 4, respectively. The feed material for campaign 4 contained considerably more material larger than 2 in. than campaigns 2 and 1. Campaign 2 had less material greater than 2 mm, but less than 9.5 mm. The fourth campaign had much less material in the less than <1-mm size fractions (3.2% vs. $\geq$ 20%) than campaigns 1 and 2. All other size fractions were similar. The values that are **italicized** in Tables 4, 5, and 6 represent material that is appropriate given the soil sieving scheme shown in Figure 1. All piles show some fine- grained material that should have been carried to the next smaller grain-sized pile. During campaign 2 almost 6% by weight finer material ended in the >6-in. pile suggesting that some feed may have missed the grizzly and ended up in the coarse reject pile. A fraction (14.9% for campaign 1, 21.4% for campaign 2, and 8.6% for campaign 4) of material <0.425 is found in oversize reject from the second vibrating screen. This suggests that the laboratory wet sieving breaks down agglomerated soils beyond the field equipment as run, and more vigorous washing or scrubbing of <2-mm soils would be beneficial prior to screening. The improved efficiency of the second vibrating screen for campaign 4 also suggests that incomplete breakdown of soils in campaigns 1 and 2 may be attributed to the agglomerated "green material." The undersize material collected in the Frac tank (that material expected to be contaminated and disposed to a burial ground) contains 6.2%, 8.6%, and 4.0% for campaigns 1, 2, and 4, respectively, oversized material that should not have passed through the second vibrating screen.

The data from the various sieving treatments on the <2 mm >0.425 mm fractions from campaigns 1 and 2 show that attrition scrubbing generates up to 10% by weight additional <0.075-mm fines. The other differences between dry sieving, wet sieving, and attrition followed by wet sieving are not consistent and likely reflect subsample heterogeneity. The attrition data appear to show that the 1- to 2-mm and 0.425- to 1-mm particle size for campaigns 1 and 2, respectively, are broken down and are contributing to the increase in <0.075-mm material.

TABLE 4. Campaign 1 - Particle-Size Distribution (wt%)

	B08MN6 Feed Material	B08MN8 >6 in.	B08MN9 >1 <6 in.	B08MP0 >2 mm <1 in.	B08MP1 >0.425 <2 mm	B08MN7 <0.425 mm
>2 in.	47.0	**99.71**	**86.70**	0.00	0.00	0.00
<2 in. >1 in.	13.4	0.00	**12.06**	0.00	0.00	0.00
<1 in. >0.5 in.	8.1	0.00	0.54	**40.04**	0.00	0.00
<0.5 in. >9.5 mm	3.3	0.00	0.03	**24.29**	0.00	0.00
<9.5 mm >2.0 mm	2.9	0.02	0.02	**34.69**	2.55	0.71
<2 mm >1.0 mm	2.3	0.02	0.02	0.57	**20.27**	0.88
<1.0 mm >0.425 mm	10.0	0.08	0.13	0.07	**62.25**	4.57
<0.425 mm >0.212 mm	5.8	0.05	0.18	0.05	11.60	**76.88**
<0.212 mm > 0.150 mm	1.3	0.01	0.05	0.01	0.52	**6.04**
<0.150 mm >0.075 mm	2.3	0.03	0.09	0.02	0.43	**4.79**
<0.075 mm	3.5	0.08	0.19	0.25	2.37	**4.12**

Particle-Size Distribution of B08MP1 Various Treatments (wt%)

	Dry Sieve	Wet Sieve	Wet Attrition
<9.5 mm >2.0 mm	0.66	2.55	0.41
<2.00 mm >1.0 mm	10.90	20.27	9.92
<1.0 mm >0.425 mm	66.03	62.25	61.99
<0.425 mm >0.212 mm	20.37	11.60	13.08
<0.212 mm > 0.150 mm	0.70	0.52	0.49
<0.150 mm > 0.075 mm	0.52	0.43	0.43
<0.075 mm	0.83	2.37	13.69

TABLE 5. Campaign 2 - Particle-Size Distribution (wt%)

	B08NM2 Feed	B08NM4 >6 in.	B08NM5 >1 <6 in.	B08NM6 >2 mm <1 in.	B08NM7 >0.425 <2 mm	B08NM3 <0.425 mm
>2 in.	38.28	**93.72**	**88.43**	0.00	0.00	0.00
<2 in. > 1 in.	15.88	5.71	**10.43**	0.00	0.00	0.00
<1 in. >0.5 in.	11.32	0.00	0.48	**23.80**	0.00	0.00
<0.5 in. >9.5 mm	3.73	0.00	0.04	**20.63**	0.00	0.00
<9.5 mm >2.0 mm	8.52	0.03	0.01	**54.35**	0.42	0.05
<2.0 mm >1.0 mm	3.46	0.02	0.01	0.63	**13.16**	0.63
<1.0 mm >0.425 mm	7.75	0.19	0.13	0.08	**64.98**	7.88
<0.425 mm >0.212 mm	5.08	0.10	0.18	0.05	15.62	**72.50**
<0.212 mm >0.150 mm	1.11	0.03	0.04	0.02	0.85	**9.45**
<0.150 mm >0.075 mm	1.91	0.06	0.08	0.03	0.75	**6.56**
<0.075 mm	2.96	0.14	0.17	0.41	4.22	**2.92**

Particle-Size Distribution of B08NM7 Various Treatments (wt%)

	Dry Sieve	Wet Sieve	Wet Attrition
<9.5 mm >2.0 mm	1.18	0.42	0.18
<2.0 mm >1.0 mm	10.50	13.16	10.13
<1.0 mm >0.425 mm	61.50	64.98	53.14
<0.425 mm >0.212 mm	22.17	15.62	20.02
<0.212 mm >0.150 mm	1.89	0.85	0.88
<0.150 mm >0.075 mm	1.71	0.75	0.76
<0.075 mm	1.05	4.22	14.90

TABLE 6. Campaign 4 - Particle-Size Distribution (wt%)

	B09758 Feed Material	B09761 >1 <6 in.	B09762 >2 mm <1 in.	B09763 >0.425 mm <2.0 mm	B09759 <0.425 mm
>2 in.	63.20	**95.42**	0.00	0.00	0.00
<2 in. >1 in.	16.75	**4.26**	0.00	0.00	0.00
<1 in. >0.5 in.	8.19	0.00	**14.46**	0.00	0.00
<0.5 in. >9.5 mm	2.32	0.00	**18.78**	0.00	0.00
<9.5 mm >2 mm	5.18	0.02	**63.79**	1.21	0.03
<2 mm >1 mm	1.14	0.01	2.92	**27.32**	1.29
<1 mm >0.425 mm	1.72	0.05	0.02	**62.86**	2.68
<0.425 mm >0.212 mm	0.45	0.03	0.01	5.86	**52.35**
<0.212 mm >0.150 mm	0.10	0.01	0.00	0.08	**9.69**
<0.150 mm >0.075 mm	0.15	0.02	0.02	0.09	**11.20**
<0.075 mm	0.82	0.17	0.01	2.58	**22.77**

Table 7 gives the wet sieving data for the two samples from campaign 3. The data suggest that the trommel was working extremely well during this test but that the second vibrating screen was rejecting up to 25.7% fine material that should have passed through the screen to be collected in the Frac tanks.

Chemical and Radionuclide Contents

The chemical and radionuclide composition the various size fraction splits from campaigns 1, 2, and 4 are found in Tables 8 to 13. Tables 8, 10, and 12 list the chemical data for 26 elements for campaigns 1, 2, and 4, respectively.

TABLE 7. Campaign 3 - Particle-Size Distribution (wt%)

	B08NM8 >2 mm <1 in.	B08NM9 >0.425 mm <2 mm
<1 in. to >0.5 in.	92.45	0.00
<0.5 in. to >9.5 mm	5.76	0.00
<9.5 to >2 mm	1.69	0.74
<2 to >1 mm	0.05	12.17
<1 to >0425 mm	0.01	61.69
<0.425 to >0.212 mm	0.01	22.50
<0.212 to >0.150 mm	0.00	1.00
<0.150 to >0.075 mm	0.00	0.51
<0.075 mm	0.03	1.30

In Tables 8, 10, and 12, the U determinations as $\mu g/g$ are converted to pCi/g to allow comparison to the γ data. The most noteworthy findings in Tables 8 and 10 are that many trace metals show a bimodal distribution with high concentrations found in the smallest size material (<0.075 mm) as expected and a second high concentration in the 1.0- to 2.0-mm size fraction. Past work (Serne et al. 1992) on sediments from the same process pond had shown concentrations to decrease fairly consistently as particle sizes increased from <0.045 to 13.2 mm.

Metals that show the bimodal distribution for campaigns 1 and 2 include Cr, Ni, Cu, Zr, Ag, Sn, Pb and U. The sediment size fractions from campaign 2 also show consistently higher concentrations (by a factor of 2 to 4) than the sediments from campaign 1. The metal concentrations of the currently studied sediment size separates for campaigns 1 and 2 are generally lower than the

TABLE 8. Campaign 1 - Metals Contents (μg/g - unless specified)

Metals	Particle Size <0.075mm	0.075-0.150mm	0.150-0.212mm	0.212-0.425mm	0.425-1.00mm	1.00-2.00mm	2.00-9.5mm
Al (%)	10.38 ± 0.6	8.48 ± 1.07	8.06 ± 0.5	7.31 ± 0.46	7.68 ± 0.4	7.86 ± 0.4	12.9 ± 1.0
Si (%)	18.0 ± 0.9	21.6 ± 1.1	27.2 ± 1.4	29.9 ± 1.5	28.0 ± 1.4	23.9 ± 1.2	16.5 ± 1.02
P (%)	0.427 ± 0.047	0.336 ± 0.045	0.216 ± 0.04	0.134 ± 0.03	0.154 ± 0.03	0.219 ± 0.04	0.116 ± 0.049
S (%)	0.074 ± 0.017	0.042 ± 0.017	0.047 ± 0.01	<0.03	<0.035	0.052 ± 0.015	<0.036
K (%)	1.06 ± 0.05	1.17 ± 0.06	1.37 ± 0.07	1.58 ± 0.08	1.34 ± 0.06	1.14 ± 0.05	0.67 ± 0.03
Ca (%)	4.1 ± 0.20	4.58 ± 0.2	3.85 ± 0.2	2.92 ± 0.14	3.40 ± 0.15	4.04 ± 0.20	4.84 ± 0.20
Ti (%)	0.54 ± 0.02	0.70 ± 0.03	0.74 ± 0.03	0.60 ± 0.03	0.716 ± 0.03	0.802 ± 0.04	1.02 ± 0.05
V	<25	136 ± 15	150 ± 15	106 ± 10	163 ± 15	190 ± 15	318 ± 20
Cr	610 ± 30	370 ± 20	211 ± 10	87.2 ± 5	105 ± 6	164 ± 9	100 ± 6
Mn	652 ± 44	826 ± 50	868 ± 50	646 ± 40	724 ± 45	874 ± 50	1291 ± 70
Fe (%)	3.62 ± 0.18	4.76 ± 0.24	4.98 ± 0.25	3.77 ± 0.15	4.45 ± 0.20	5.26 ± 0.25	7.13 ± 0.3
Ni	756 ± 40	500 ± 25	278 ± 15	85 ± 7	142 ± 10	233 ± 15	128 ± 10
Cu	6700 ± 330	4980 ± 250	2675 ± 130	702 ± 35	1195 ± 60	2660 ± 130	878 ± 40
Zn	184 ± 12	130 ± 9	104 ± 8	70.3 ± 5	80.1 ± 6	101 ± 7.5	109 ± 7
As	9.8 ± 3.4	<6	<8	<4	<5.5	<4.6	<4.4
Se	<2.2	<2.2	<2.1	<2	<2	<2.1	<2.2
Rb	152 ± 13	88.6 ± 7	67 ± 5	55.4 ± 4	56.7 ± 4	61.4 ± 5	25.6 ± 3
Sr	416 ± 29	368 ± 25	377 ± 25	391 ± 25	383 ± 25	352 ± 20	256 ± 15
Zr	2740 ± 190	1675 ± 120	940 ± 60	284 ± 20	450 ± 30	953 ± 60	426 ± 30
Ag	72 ± 7	44 ± 5	20.3 ± 4	<9.6	11.6 ± 4	24.1 ± 8.2	14.0 ± 4.5
Cd	<10	<10	<8.8	<10	<9.5	<10	<10
Sn	145 ± 12	69 ± 7	50.7 ± 6	<12	16 ± 6	39 ± 6	<14
Ba	2400 ± 170	1320 ± 90	1062 ± 75	936 ± 60	912 ± 60	958 ± 60	588 ± 40
Hg	8.1 ± 3.5	<8	<8	<6	<6	9.1 ± 3.4	<7.5
Pb	132 ± 8	94.5 ± 6	55 ± 4	30.7 ± 3.5	33.4 ± 3	43.2 ± 5.6	32.8 ± 3.5
U	5540 ± 380	2130 ± 150	1154 ± 80	329 ± 20	664 ± 40	1307 ± 90	672 ± 45
U (pCi/g)	1939	746	404	115	232	457	235

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TABLE 9. Gamma Activity (pCi/g) for Campaign 1

Nuclides	Particle Size (mm) or in. (")										
	<0.075	0.075-0.150	0.150-0.212	0.212-0.425	0.425-1.0	1.0-2.0	2.0-9.5	9.5-0.5"	0.5"-1.0"	1.0"-2.0"	>2.0"
^{238}U	918 ± 640	356 ± 5	212 ± 37	68 ± 10	124 ± 8	229 ± 13	86 ± 67	No Sample	0.2	0.2	0.04
^{235}U	143 ± 140	35 ± 6	21 ± 6	<6	13 ± 1	22 ± 1	10 ± 8		<0.07	<0.1	<0.02
^{60}Co	<6	<3	<1.2	<5	<8	<6	<4		<0.3	<0.1	<0.07
^{137}Cs	<5	<3	<1.5	<3.5	<4	<6	<4		<0.3	<0.05	<0.7
Ratio U XRF/γ	2.11	2.10	1.91	1.69	1.87	2.00	2.73		--	--	--

TABLE 10. Campaign 2 - Metals Content (μg/g unless specified)

Metals	Particle Size <0.075mm	0.075-0.150mm	0.150-0.212mm	0.212-0.425mm	0.425-1.00mm	1.00-2.00mm	2.00-9.5mm
Al (%)	8.92 ± 0.50	8.56 ± 0.4	7.6 ± 0.9	7.4 ± 0.4	7.52 ± 0.3	8.66 ± 0.3	7.93 ± 0.4
Si (%)	11.78 ± 0.60	18.7 ± 0.9	22.8 ± 1.0	25.6 ± 1.0	27.2 ± 1.0	18.35 ± 0.8	20.45 ± 0.5
P (%)	0.449 ± 0.036	0.362 ± 0.03	0.28 ± 0.03	0.23 ± 0.02	0.21 ± 0.03	0.45 ± 0.03	0.35 ± 0.03
S (%)	0.075 ± 0.012	0.050 ± 0.01	0.035 ± 0.01	0.044 ± 0.01	0.055 ± 0.01	0.088 ± 0.017	<0.03
K (%)	0.75 ± 0.03	1.00 ± 0.05	1.20 ± 0.06	1.33 ± 0.06	1.42 ± 0.06	0.90 ± 0.04	0.90 ± 0.02
Ca (%)	4.54 ± 0.23	4.82 ± 0.20	3.89 ± 0.20	3.22 ± 0.10	3.80 ± 0.10	4.65 ± 0.20	5.07 ± 0.20
Ti (%)	0.42 ± 0.02	0.66 ± 0.03	0.79 ± 0.03	0.57 ± 0.02	0.74 ± 0.03	0.70 ± 0.03	1.14 ± 0.03
V	<16	103 ± 18	176 ± 10	110 ± 5	154 ± 10	175 ± 10	328 ± 15
Cr	743 ± 62	450 ± 20	307 ± 50	238 ± 5	154 ± 5	315 ± 110	204 ± 10
Mn	805 ± 40	878 ± 50	900 ± 50	655 ± 20	752 ± 20	816 ± 20	1143 ± 40
Fe (%)	2.86 ± 0.14	4.81 ± 0.20	5.54 ± 0.25	3.81 ± 0.10	4.34 ± 0.10	4.86 ± 0.20	7.19 ± 0.3
Ni	976 ± 60	678 ± 30	440 ± 90	350 ± 10	238 ± 10	712 ± 20	475 ± 43
Cu	9590 ± 700	6885 ± 300	4245 ± 813	3630 ± 130	2825 ± 100	9225 ± 200	5880 ± 440
Zn	254 ± 12	152 ± 9	127.6 ± 11	101 ± 5	96.4 ± 5	155 ± 7	156 ± 5
As	6.4 ± 2.0	6.7 ± 2.0	5.6 ± 1.8	5.1 ± 1.0	<4	<5	5.7 ± 3.0
Se	<1.6	<1.6	<1.6	<1.4	<1.5	<1.6	<1.6
Rb	240 ± 15	94.5 ± 8	67.2 ± 5	70.4 ± 5	61.4 ± 5	96.2 ± 14	53.1 ± 4
Sr	446 ± 30	368 ± 20	372 ± 20	372 ± 25	367 ± 20	326 ± 10	397 ± 10
Zr	3840 ± 260	2610 ± 150	1675 ± 250	1355 ± 80	1058 ± 40	3255 ± 50	2225 ± 150
Ag	109 ± 9	71 ± 6	43.8 ± 5	34.2 ± 5	17.0 ± 2.0	51.9 ± 4.0	35.0 ± 4.0
Cd	<8	<9	<9	<8	<7.5	<8.5	<7.8
Sn	234 ± 25	104 ± 10	71 ± 23	48.6 ± 5	36.8 ± 5	88.3 ± 5	52.3 ± 3
Ba	4625 ± 300	1490 ± 100	1113 ± 80	1014 ± 50	988 ± 40	835 ± 20	557 ± 20
Hg	12.4 ± 2.5	9.6 ± 2.5	<5.6	<4.6	<4.5	8.0 ± 2.5	7.7 ± 3.0
Pb	179 ± 9	113 ± 5	75.0 ± 8	61.6 ± 4	45.0 ± 3	91 ± 17	43.5 ± 5
U	8615 ± 445	2855 ± 180	1695 ± 260	1387 ± 80	1301 ± 50	3275 ± 50	1685 ± 134
U (pCi/g)	3015	999	593	485	455	1146	590

TABLE 11. Gamma Activity (pCi/g) for Campaign 2

Nuclides	Particle Size (mm) or In. (") <0.075	0.075-0.150	0.150-0.212	0.212-0.425	0.425-1.0	1.0-2.0	2.0-9.5	9.5-0.5"	0.5"-1.0"	1.0"-2.0"	>2.0"
^{238}U	1248 ± 122	566 ± 97	252 ± 45	212 ± 173	171 ± 40	339	211	4.6	4.4	0.95	3.8
^{235}U	156 ± 65	58 ± 12	28 ± 8	24 ± 14	20 ± 2	52	29	<0.8	0.5	0.13	0.5
^{60}Co	<6	<6	<2	<1.3	<1.0	<1.8	<0.6	<1.5	<0.2	<0.08	<0.05
^{137}Cs	<6	<7	<3	<1.3	<0.9	<1.5	<0.6	<1.1	<0.2	<0.05	<0.3
Ratio U XRF/γ	2.42	1.76	2.35	2.29	2.66	3.38	2.80	--	--	--	--

TABLE 12. Campaign 4 - Metals Content (μg/g unless specified)

Metals	Particle Size						
	<0.075mm	0.075-0.150mm	0.150-0.212mm	0.212-0.425mm	0.425-1.00mm	1.00-2.00mm	2.00-9.5mm
Al (%)	9.18 ± 0.5	6.81 ± 0.44	6.40 ± 0.4	5.91 ± 0.40	6.44 ± 0.42	7.08 ± 0.44	6.40 ± 0.41
Si (%)	23.4 ± 1.2	25.6 ± 1.3	26.2 ± 1.4	26.6 ± 1.3	24.0 ± 1.3	25.8 ± 1.3	26.0 ± 1.3
P (%)	<0.064	<0.07	<0.07	<0.07	0.1 ± 0.04	0.09 ± 0.04	<0.08
S (%)	0.047 ± 0.01	0.035 ± 0.01	0.032 ± 0.01	0.036 ± 0.01	0.038 ± 0.012	0.04 ± 0.01	0.05 ± 0.01
K (%)	1.87 ± 0.09	1.32 ± 0.07	1.34 ± 0.06	1.34 ± 0.07	1.06 ± 0.05	1.12 ± 0.06	1.36 ± 0.07
Ca (%)	2.31 ± 0.12	3.48 ± 0.17	3.24 ± 0.16	3.4 ± 0.2	4.5 ± 0.2	4.9 ± 0.25	4.92 ± 0.25
Ti (%)	0.70 ± 0.04	1.04 ± 0.05	0.95 ± 0.05	0.96 ± 0.05	1.32 ± 0.07	1.37 ± 0.07	1.34 ± 0.07
V	203 ± 14	346 ± 22	311 ± 19	308 ± 19	448 ± 26	462 ± 27	436 ± 2.6
Cr	193 ± 10	117 ± 7	107 ± 6	85 ± 5	33.5 ± 3.7	39.3 ± 4	18.7 ± 3.5
Mn	1200 ± 64	1258 ± 70	1093 ± 60	1044 ± 56	1360 ± 72	1393 ± 75	1634 ± 85
Fe (%)	5.89 ± 0.3	8.00 ± 0.4	6.73 ± 0.34	6.13 ± 0.31	8.48 ± 0.4	8.68 ± 0.4	8.49 ± 0.43
Ni	182 ± 11	102 ± 6.7	66 ± 5	61 ± 4	46 ± 4	36 ± 4	20.4 ± 3.4
Cu	2310 ± 115	1425 ± 70	1036 ± 53	997 ± 50	716 ± 37	300 ± 16	120 ± 7
Zn	185 ± 10	167 ± 9	146 ± 8	129 ± 7	129 ± 7	125 ± 7	125 ± 7
As	10.3 ± 1.1	6 ± 3	5.5 ± 1.0	3.8 ± 1.0	4.8 ± 1.0	4.1 ± 1.0	3.5 ± 1.0
Se	<1.1	<1.2	<1.3	<1.2	1.3 ± 0.6	<1.3	<1.3
Rb	108 ± 8	55 ± 6	54 ± 4	52 ± 4	34 ± 3	31 ± 2.8	41 ± 3
Sr	267 ± 20	347 ± 25	345 ± 24	370 ± 26	328 ± 23	311 ± 22	322 ± 23
Zr	971 ± 67	698 ± 50	556 ± 39	516 ± 35	230 ± 16	201 ± 14	188 ± 14
Ag	48 ± 7	21 ± 5	16 ± 5	15 ± 7	<13	<13	<12
Cd	<13	<12	<15	<15	17 ± 7	<14	<13
Sn	<20	22 ± 6	28 ± 9	21 ± 7	<15	<16	<14
Ba	890 ± 50	673 ± 40	682 ± 43	670 ± 40	614 ± 40	644 ± 40	794 ± 45
Hg	<4.7	<5.0	<5.0	<4.8	<5.0	<5.0	<5.0
Pb	38 ± 3	26 ± 2	20.3 ± 2.2	17.2 ± 2.0	6.8 ± 1.9	<5	8 ± 2
U	186 ± 15	97 ± 7	86 ± 7	82.4 ± 6.6	21.6 ± 3.0	9.4 ± 2.7	9.0 ± 5.2
U (pCi/g)	65	34	30.1	28.8	7.6	3.3	3.2

sediments studied earlier (Serne et al. 1992) for Cr, Cu, and Zr; about the same for Zn and Ag; and higher for Ni, Pb, and U. Campaign 4 sediments contain low concentrations of Cr, Ni, Cu, Zr, Ag, Sn, Pb, and U relative to campaigns 1 and 2. Campaign 4 sediments are enriched in Si, V, Mn, and Fe, common elements in natural soil minerals, compared to campaigns 1 and 2.

For the chemical data it is not clear why the 1.0- to 2.0-mm-sized material should be enriched in trace metals. There does appear to be a slight increase in Al, P, and S content--perhaps suggesting the existance of aluminum hydroxide, phosphate, and sulfate precipitates.

The gamma analyses are listed in Tables 9, 11, and 13 for campaigns 1, 2, and 4, respectively. The gamma counting results for campaigns 1 and 2 also show the bimodal distribution versus particle size for the ^{238}U and ^{235}U isotopes. The second activity peak occurs in the 1- to 2-mm and 2- to 9.5-mm-size fractions. None of the size separates contain significant levels of ^{60}Co or ^{137}Cs. Campaign 4 does not show the bimodal distribution in uranium activity and also is significantly less contaminated in uranium than sediments in campaign 1 and 2. Compared to U activity measured on dry sieved samples in 1992 (Serne et al. 1992), campaign 2 samples are slightly higher than past samples and campaign 1 and 4 data are similar to past samples excepting the bimodal peak in the 1- to 9.5-mm-size fractions for campaigns 1 and 2.

Tables 9, 11, and 13 also show that there is considerable disagreement between the U content as measured by the two independent techniques. Unlike past comparisons (Serne et al. 1992), the XRF data for campaigns 1 and 2 show consistently higher values for U than the γ measurements. The source of the differences is not readily apparent and will be further explored. For the present, we will use the XRF data to ensure that we are being conservative when discussing the clean-up potential of the soil washing tests.

The feed material in the 300 Area North Process Pond is very diverse in particle size from >6-in. boulders to clay-sized particles. It is difficult to obtain an accurate analysis of the bulk material to determine contaminant

TABLE 13. Gamma Activity (pCi/g) for Campaign 4

Nuclides	Particle Size (mm) or in. (")										
	<0.075	0.075-0.150	0.150-0.212	0.212-0.425	0.425-1.0	1.0-2.0	2.0-9.5	9.5-0.5"	0.5"-1.0"	1.0"-2.0"	>2.0"
^{238}U	54 ± 1	35 ± 4	23.3	15.2 ± 0.3	5.8 ± 0.2	2.9 ± 1.2	<0.9	<0.67	0.72	0.45	<0.17
^{235}U	1 ± 0.7	4.9 ± 1.2	3.2	2.3 ± 0.2	1.0 ± 0.1	0.6 ± 0.03	<0.2	<0.14	<0.05	0.07	<0.04
^{60}Co	<2.5	<1.4	<0.8	<0.5	<0.3	<0.4	<0.3	0.27	<0.27	0.04	<0.06
^{137}Cs	2.6 ± 0.9	5.7 ± 0.6	<0.8	<0.5	<0.5	<0.4	<0.3	0.38	0.09	0.12	<0.05
Ratio U XRF/γ	1.20	0.97	1.29	1.89	1.31	1.14	3.6	--	--	--	--

Feed Material <2 mm Size Fraction

^{238}U	2.93
^{235}U	0.56
^{60}Co	<0.25
^{137}Cs	0.21

concentrations. We elected to measure the contaminant concentrations in each of the sieved size fractions from >2 in. down to <0.075 mm and then reconstruct a bulk sediment concentration based on summing the product of the measured concentration in each size fraction times the fraction of total weight residing in each size fraction.

Based on the data found in Tables 4, 5, and 6 (particle-size distribution) and Tables 8, 10, and 12 (^{238}U activities calculated from XRF chemical analyses) we can calculate the concentration of uranium in the feed material and each of the piles (see Figure 1) generated during soil washing. Using the chemical data in Tables 8, 10, and 12, one can also calculate trace material concentrations in the feed and various piles, although such calculations are not shown herein.

Using the calculated contaminant concentrations in the feed material and washed piles and pre-determined clean-up goals, the efficiency of physical soil washing can be determined. Using a ^{238}U clean-up goal of 370 pCi/g and the data presented in Tables 4, 5, 6, 8, 10, and 12, we can make the following observations. The feed material in campaigns 1 and 4 were considerably below the clean-up goal of 370 pCi/g, but campaign 2 feed material containing ~270 pCi/g ^{238}U was close to the limit. Because of the bimodal distribution of uranium in the sediments from campaign 1 and 2, the pile of sediment rejected by the second screen (0.425 to 2 mm) is just below and considerably greater than the clean-up goal of 370 pCi/g, respectively. Further for campaign 2 the 2-mm to 1 in. pile also is very close to the clean-up goal. As expected, all of the piles generated during campaign 4, including the fines collected in the Frac tank, easily meet the clean-up goal. Also for campaign 4 the concentration of ^{238}U in processed soils was 4 times lower in the 2- to 0.425-mm pile and approximately 100 times lower in the >1-in. pile as compared to the <0.425-mm soils transferred to the Frac tanks. Specific values for the calculated ^{238}U concentrations in the various piles are shown in Table 14.

Green and White Agglomerates

As mentioned in the last section the green and white agglomerates caused several of the field washed piles to remain more radioactive than desired.

TABLE 14. Calculated ^{238}U Content (pCi/g) of Various Field Washed Sediment

	Feed Material	>1 in. Piles (2)	1 in. to 2-mm Pile	2- to 0.425-mm Pile	<0.425-mm Frac Tank
Campaign 1	137.7	2.2 to 5.3	91	308	245
Campaign 2	267.0	10.4 to 11.3	343	664	605
Campaign 4	1.4	0.3	2.4	9.1	37

Additional characterization was performed to aid in understanding the nature of the agglomerates and how they may be better treated.

Table 15 lists the chemical and radionuclide analyses performed on the green-and white-colored particles that were hand segregated from campaign 1 and 2 materials in the 2- to 9.5-mm and 1- to 2-mm-sized material. Recall that it was these two size fractions that contained the second peak in contaminants (bimodal distribution). The chemical data are presented as metal oxides to allow a complete mass balance. Sodium and magnesium data, not measurable by XRF, were obtained by atomic absorption analyses after complete sample fusion. The loss of weight (LOI) upon ignition to 900°C is also shown.

The LOI represents bound water (hydrous oxides and hydroxides) and carbonate minerals. The complete chemical analysis is a useful aid in determining the mineralogy that was measured with x-ray diffraction techniques.

Comparing data in Table 15 and Appendix C with the XRF chemical analysis for bulk sediments from campaigns 1 and 2 that were from the same particle size (see Tables 10 and 12 and Appendix B) the following statements are possible. The green and white particles contain significantly greater amounts of Al and significantly lower amounts of Si, K, Ti, Mn, Fe, Ba and S than the bulk sediment. This suggests that the green and white particles are enriched in aluminum oxides and hydroxides caused by the precipitation of formerly dissolved Al ions from fuel element cladding.

The green particles are significantly enriched in Cr, Ni, Cu, Zn, Zr, Ag, Pb and U compared to the bulk sediment with the same particle sizes. These metals also likely precipitated as the aluminum hydroxide/oxides formed or were scavenged from solution by adsorption reactions on the precipitated aluminum material.

TABLE 15. Chemical and Gamma Radionuclide Contents of Green and White Particles

Chemical Content wt% as oxide	Campaign 1 Green 2-9.5 mm	Campaign 1 Green 1-2 mm	Campaign 1 White 2-9.5 mm	Campaign 1 White 1-2 mm	Campaign 2 Green 2-9.5 mm	Campaign 2 Green 1-2 mm	Campaign 2 White 2-9.5 mm	Campaign 2 White 1-2 mm
Na_2O	1.62	0.22	0.84	1.50	0.81	0.39	0.57	0.75
MgO	4.20	2.76	0.17	0.80	4.17	3.32	0.06	0.59
Al_2O_3	22.54	32.14	52.15	45.93	27.06	30.27	61.73	55.25
SiO_2	27.04	5.41	8.41	21.61	13.82	10.01	2.40	2.38
K_2O	0.39	0.16	0.09	0.29	0.27	0.15	0.02	0.06
CaO	8.65	7.44	2.55	2.83	9.36	7.56	0.01	2.15
TiO_2	0.17	0.05	0.03	0.06	0.11	0.04	0.00	0.03
Cr_2O_3	0.24	0.19	0.00	0.02	0.25	0.12	0.00	0.01
MnO_2	0.05	0.05	0.00	0.01	0.06	0.06	0.00	0.00
Fe_2O_3	2.39	0.66	0.19	0.51	2.26	0.47	0.05	0.15
NiO	0.32	0.32	0.00	0.03	0.40	0.24	0.00	0.01
CuO	4.34	7.75	0.02	0.17	5.63	7.60	0.03	0.14
ZnO	0.04	0.04	0.00	0.01	0.05	0.02	0.00	0.00
SrO	0.04	0.03	0.01	0.02	0.03	0.02	0.00	0.01
PbO	0.03	0.03	0.00	0.01	0.04	0.02	0.00	0.00
ZrO_2	2.54	1.85	0.01	0.09	2.72	1.59	0.01	0.03
Ag_2O	0.02	0.02	0.00	0.00	0.03	0.02	0.00	0.00
SnO_2	0.05	0.04	0.01	0.01	0.05	0.05	0.00	0.00
BaO	0.05	0.03	0.01	0.04	0.04	0.03	0.00	0.00
Ce_2O_3	0.02	0.00	0.00	0.00	0.02	0.00	0.00	0.00
UO_2	1.60	1.75	0.10	0.19	2.18	1.43	0.06	0.16
Loss on Ignition at 900°C	22.24	33.92	31.47	27.24	29.59	36.61	34.71	37.96
Total	98.59	94.85	96.05	101.36	98.96	100.00	99.76	99.69
γ Content pCi/g								
^{238}U	2.9	3060	1.4	450	2500	423	88	382
^{235}U	<1.4	36.4	0.7	34	295	34	7.7	<82.2
^{60}Co	5	<48	2	<25	16	<22	<1	<126
^{137}Cs	52	<44	25	<21	24	<24	<6	<105

The white-colored particles are not as enriched in transition metals and uranium but do contain the highest concentrations of aluminum. If adsorption onto aluminum oxides/hydroxides were the dominant process we would expect that the white particles would also contain high levels of metal contaminants. Thus, precipitation rather than adsorption is the likely cause of enriched metals in the green particles. The white-colored particles contain significantly lower amounts of calcium than the green particles and bulk sediment.

The gamma ray counting data for uranium isotopes in Table 15 are not as consistent as the XRF data largely because of the small number of particles available for counting, and for some samples, short counting time allotted. The data do show more gamma activity (predominately the ^{234}Th daughter of ^{238}U) in the green particles. Table 16 compares the XRF and γ counting data for the green and white particles using the conversion factor that 1 ppm natural uranium is equivalent to 0.35 pCi/g. The uranium in the pond sediments is slightly enriched in ^{235}U compared to natural abundances but the correction to convert ppm to pCi would be small and was ignored.

All of the XRF analyses show that these coarse green particles (>1 mm to <9.5 mm) contain uranium at levels above the target value of 370 pCi/g. The white particles (>1 mm to <2 mm) also exceed the clean-up goal. The green and white particles can be further disaggregated when dry by pinching them between your thumb and finger because the material is fine precipitates cemented together with "sticky" aluminum hydroxide/oxides. But recall that these agglomerates did survive both field physical soil washing and laboratory wet sieving.

Subsamples of the green and white agglomerates from both campaigns 1 and 2 were crushed to powder consistency and mounted on slides for x-ray diffraction measurements. Because the green material exceeded radioactive limits for dispersible samples, the green powder samples were coated with collodion, an organic binder. The use of collodion causes amorphous background interferences that make the interpretation of the diffraction patterns a challenge.

TABLE 16. Comparison of U Data in Green and White Particles Measured by Two Independent Techniques

Campaign 1	XRF Data (ppm)	Conversion (pCi/g)	Rad Data (^{238}U & ^{235}U) (pCi/g)
Green Particles			
>2 mm	13570	4750	4.5
>1 mm	14800	5180	3100
White particles			
>2 mm	858	300	2
>1 mm	1630	570	485
Campaign 2			
Green Particles			
>2 mm	18,500	6475	2800
>1 mm	12,120	4240	460
White Particles			
>2 mm	533	185	96
>1 mm	1363	480	464

The white material was not as radioactive and thus could be run directly allowing for excellent diffraction patterns. The results of the mineralogic analyses are found in Table 17. The white material is almost entirely gibbsite, an aluminum hydroxide. Two other aluminum oxide/hydroxides are also present in small quantities. A trace of calcite is also present in the white material. We attempted to locate U- and Cu-bearing crystalline phases using computer peak matching of all available minerals. There were several uranium (VI) bearing minerals that could be cause of several very weak diffractograms.

TABLE 17. Mineralogic Analysis of Green and White Agglomerates

	Campaign 1		Campaign 2	
White Material	Gibbsite [(Al(OH)$_3$]	95%	Gibbsite	95%
	Boehmite AlOOH	<5%	Bayerite	<5%
	Bayerite [Al(OH)$_3$]	<1%	Calcite	trace
	Calcite $CaCO_3$	trace	Ikaite $CaCO_3 \cdot 6H_2O$	trace
	$MgUO_{3.8}$	possible	$MgUO_{3.8}$	possible
	MgU_2O_6	possible	MgU_2O_6	possible
			$CaUO_{4.5}$	possible
			U_3O_8	possible
Green Material	Calcite	major	Calcite	80%
	Gibbsite	minor	Gibbsite	>5%
	7 unidentified peaks obscured by amorphous or collodion background		Quartz	>5%
			Albite (-type)	>5%

The green material is predominantly calcite with minor amounts of aluminum hydroxide and quartz. Although Cu and U are present in the green material at much higher concentrations than in the white material, no positive identification of crystalline material was possible for Cu- and U-bearing minerals. The requirement that collodion be used to minimize dispersion potential impaired diffraction pattern interpretation.

Figures 2 and 3 are color photographs of the green and white agglomerates (2- to 9.5-mm-size fraction) as seen through a low-power optical microscope. The green material is dense, low porosity material with rather rounded edges. The material looks cemented as commonly found for calcitic rich material. The rounded edges may reflect the soft plastic nature of the agglomerates. That is, the edges may readily abrade but they maintain their agglomerization like wet clay balls. The white agglomerates are much more porous looking and show more surface roughness.

Upon further magnification under a scanning electron microscope both agglomerates appear to be small ≤20-μm crystallites cemented together.

FIGURE 2. Optical Microscope Picture of Green Particle >2 mm

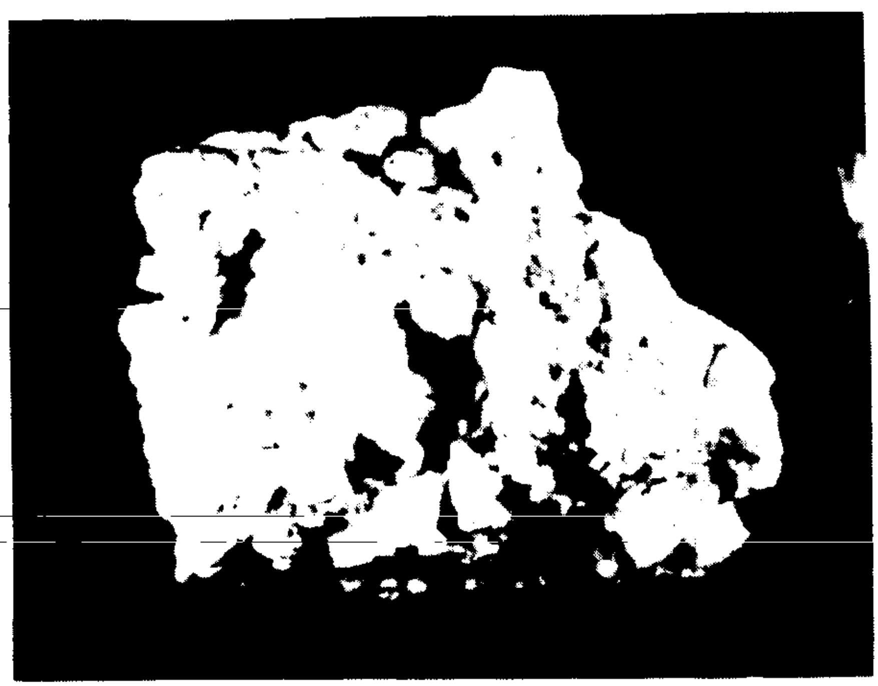

FIGURE 3. Optical Microscope Picture of White Particle >2 mm

Figures 4 and 5 show the green and white agglomerates, respectively, at 500 times magnification under backscattered secondary electron conditions. Heavy elements show up as bright spots under the backscattering conditions. Figure 4 shows several distinct very bright particles that are enriched in uranium, cerium, copper, and zirconium. Although less frequent, similar bright spots are observable in the white agglomerates. These bright spots contain enriched uranium and copper.

The microscopy and energy dispersive X-ray analysis of the spots confirm that the green and white agglomerates are respectively calcite cemented and aluminum hydroxide co-precipitated small crystallites of various composition. Very fine-grained crystallites, highly enriched in uranium, copper, zirconium, and probably other metals are captured within the agglomerates.

Neither calcite nor gibbsite are very hard minerals such that they may be broken down during vigorous attrition scrubbing. The two matrix minerals are "sticky" in nature and when moist may roll into clay-like balls. If the overall size is not readily diminished by attrition scrubbing to a favorable size, <0.425 mm, some chemical addition to promote clay dispersion or matrix dissolution could be performed. Both $CaCO_3$ and $Al(OH)_3$ will dissolve in mildly acidic conditions and sodium hexametaphosphate or other appropriate dispersing agents might aid in agglomerate disaggregation.

Attrition Scrubbing

A portion of two samples from the >0.425- to <2-mm piles from campaigns 1 and 2 were attrition scrubbed then wet sieved. The particle-size data are shown on Tables 4 and 5, respectively. Unfortunately the dried sediments in each of the sieve fractions <0.075 mm through >2.0 to 9.5 mm from the two samples were mixed together forming one sample for each sieve fraction. Therefore we cannot discuss the impact of attrition scrubbing on each individual field campaign. We can discuss the overall impact of attrition scrubbing on the mixed sediment. Table 18 shows the γ ray analyses of combined campaign

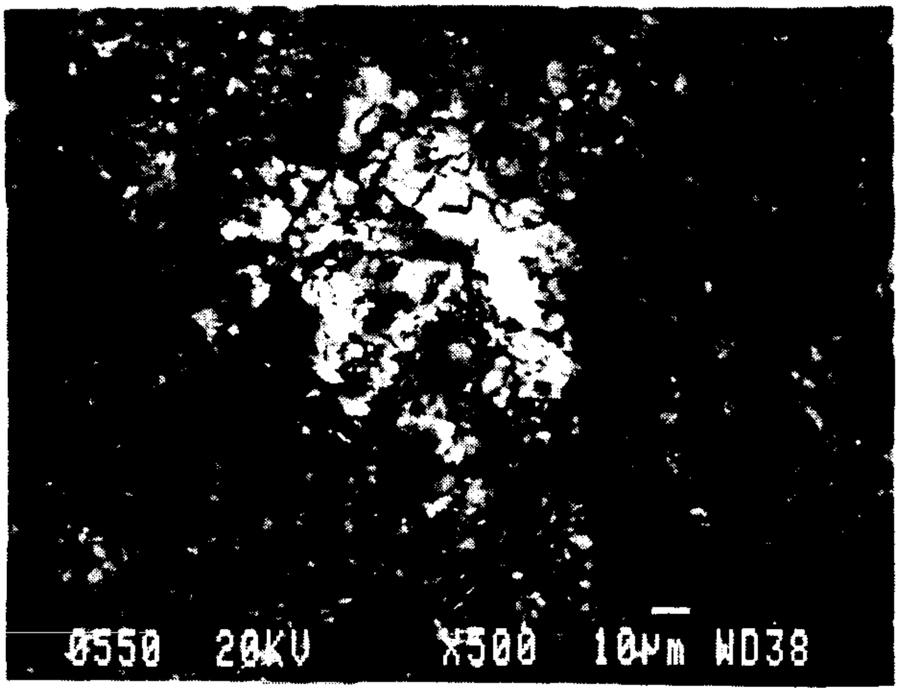

FIGURE 4. Scanning Electron Microscope Picture of Micron-Sized Crystallites in Green Particle >2 mm

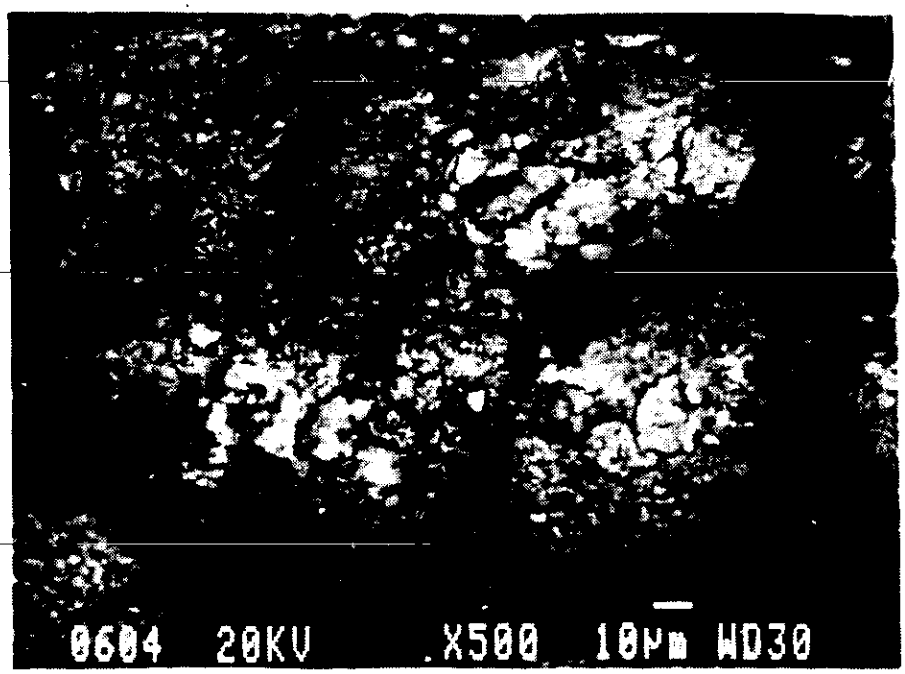

FIGURE 5. Scanning Electron Microscope Picture of Micron-Sized Crystallites in White Particle >2 mm

TABLE 18. U Isotope Analyses (pCi/g)

Size	Attrition Scrubbed Campaigns 1 and 2		Wet Sieve Campaign 1		Wet Sieve Campaign 2	
	^{238}U	^{235}U	^{238}U	^{235}U	^{238}U	^{235}U
>0.075 mm	777 ± 300	103 ± 3	918 ± 640	143 ± 140	1248 ± 122	156 ± 65
0.075-0.150 mm	190 ± 4.2	14 ± 0.3	356 ± 5	35 ± 6	566 ± 97	58 ± 12
0.150-0.212 mm	75.2	10.4	212 ± 37	21 ± 6	252 ± 45	28 ± 8
0.212-0.425 mm	35.4 ± 0.4	3.8 ± 0.4	68 ± 10	<6	212 ± 173	24 ± 14
0.425-1.0 mm	50.8 ± 1.3	6.3 ± 0.9	124 ± 8	13 ± 1	171 ± 40	20 ± 2
1.0-2.0 mm	28.1 ± 5.8	2.8 ± 0.8	229 ± 13	22 ± 1	339	52
2.0-9.5 mm	33.7 ± 16.3	4.1 ± 0.2	86 ± 67	10 ± 8	211	29

1 and 2 material after attrition scrubbing/wet sieving and the individual sediments after wet sieving only (same data as shown in Tables 9 and 11). We did not perform XRF analyses on the dry sieved or attrition scrubbed material so we cannot discuss the fate of other trace metals or compare U data as measured by the two independent procedures.

The gamma-ray data suggest that attrition scrubbing removes uranium from all the size fractions. To determine whether there is a net dissolution of uranium or whether the activity is diluted into the large increase in <0.075-mm material created upon attrition scrubbing we had to calculate a starting activity on the original material in the >0.425- to <2-mm piles for campaigns 1 and 2 and compare these values with the final activity in the attritioned material. This is done by multiplying the measured U activities (pCi/g) in each sieve size by the fraction of the total original weight found in that size fraction and summing the products across all size fractions. This calculation is done in Table 19 using only gamma-ray data. Similar calculations for the campaign 1 and 2 wet sieved material using XRF data, that yielded higher U values, are shown in Table 14.

TABLE 19. Distribution of ^{238}U (pCi/g) in Size Fractions From the 0.425- to 2-mm Piles (Before and After Attrition Scrubbing)

Size	Fraction Wt.		U Activity		pCi/g
			Campaign 1		
<0.075 mm	.0237	•	918 ± 640	=	21.8 ± 15.2
0.075-0.150 mm	.0043	•	356 ± 5	=	1.5 ± 0.0
0.150-0.212 mm	.0052	•	212 ± 37	=	1.1 ± 0.2
0.212-0.425 mm	.1160	•	68 ± 10	=	7.9 ± 1.2
0.425-1.0 mm	.6225	•	124 ± 8	=	77.2 ± 5.0
1.0-2.0 mm	.2027	•	229 ± 13	=	46.4 ± 2.6
2.0-9.5 mm	.0255	•	86 ± 67	=	2.2 ± 1.7
Total Sample					158.1 ± 25.9
			Campaign 2		
<0.075 mm	.0422	•	1248 ± 122	=	52.7 ± 5.1
0.075-0.150 mm	.0075	•	566 ± 97	=	4.2 ± 0.7
0.150-0.212 mm	.0085	•	252 ± 45	=	2.1 ± 0.4
0.212-0.425 mm	.1562	•	212 ± 173	=	33.1 ± 27.0
0.425-1.0 mm	.6498	•	171 ± 40	=	111.1 ± 26.0
1.0-2.0 mm	.1316	•	339	=	4.5
2.0-9.5 mm	.0042	•	211	=	0.9
Total Sample					208.6 ± 59.2
			Attrition Sediment		
<0.075 mm	.1429	•	777 ± 300	=	111.0 ± 43
0.075-0.150 mm	.0059	•	190 ± 42	=	1.1 ± 0.2
0.150-0.212 mm	.0068	•	75.2	=	0.5
0.212-0.425 mm	.1650	•	35.4 ± 0.4	=	5.8 ± 0.1
0.425-1.00 mm	.5763	•	50.8 ± 1.3	=	29.3 ± 0.7
1.0-2.0 mm	.1002	•	28.1 ± 5.8	=	2.8 ± 0.1
2.0-9.5 mm	.0030	•	33.7 ± 16.3	=	0.1 ± 0.05
Total Sample					150.6 ± 44

There is a change in the uranium distribution versus particle size after attrition scrubbing. Prior to attrition scrubbing, 80% of the uranium in the 0.425- to 2-mm pile from campaign 1 is found in particles >0.425 mm, and 56% of the uranium is found in similar sized particles in campaign 2. After attrition scrubbing and wet sieving, only 21% of the uranium activity remains in particles greater than 0.425 mm.

After attrition scrubbing, the combined material from campaigns 1 and 2 that remained with particle sizes above 0.425 mm had a ^{238}U content of 47 ±1 pci/g. This value easily meets the clean-up goal of 370 pci/g and is considerably lower than the values for the 0.425- to 2-mm piles left in the field (158 and 209 pCi/g using gamma data and 308 and 664 pCi/g using XRF-uranium data - see Table 14). Attrition scrubbing of the 0.425- to 9.5-mm particles should generate more fines (break up green and white agglomerates) and transfer significant amounts of activity to the desired size fraction <0.425 μm. Pilot-scale testing would be required to see if full-scale attrition scrubbing would, in fact, remove enough additional activity to lower the activity of the 0.425- to 2-mm and 2-mm to 1 in. piles generated by the current washing scheme.

Process Water Analyses

Analyses were also performed on the spent process water separated from the fines (<0.425 mm) collected in the Frac tanks at the end of field tests (campaigns 1, 2, and 4). The water separation for campaign 4 was performed in the field soon after test completion, whereas the waters separated from campaign 1 and 2 fines was in contact with the fines for about 6 weeks. We will keep this fact in mind and attempt to see if the prolonged contact time may have allowed additional dissolution of contaminants such as uranium. All water samples were filtered through 0.45-μm membranes prior to chemical analyses.

In addition, aliquots of the water used in the laboratory wet sieving activities for each sediment pile (see Table 2) were also filtered (0.45 μm) and analyzed for selected chemicals. These water samples contacted bulk sediments at a ratio of 4:1 water to solids for short time periods (<1 hour) but were in contact with suspended sediments <0.075 mm for longer time periods prior to filtration. Further, the sediments, excepting feed samples, had already been field washed prior to being sent to the lab. The laboratory filtration step was performed more quickly for campaign 4 rinses than for campaign 1 and 2 rinses. A comparison of the chemical composition of the laboratory wet sieving water and spent field process water may help in selecting appropriate water treatment schemes, if treatment is necessary.

Table 20 contains the chemical analyses of the process waters separated from the fines generated in the various field tests. Table 21 contains chemical analyses of selected species in the laboratory wet sieve rinse waters from campaigns 1, 2, and 4. For Table 21 note that some values are reported as milligrams per liter and others as micrograms per liter.

The data in Table 20 suggest that campaigns 1 and 2 may leach significant quantities of uranium and some chromium from the 300 Area North Process Pond sediments during field soil washing. Recall that waters remained in contact with fine sediments for several weeks prior to filtration and analysis, so that the data may include sustained leaching of suspended fines that will not occur during field operation. Campaign 4 waters were separated from the fine sediments soon after the field demonstration and show much lower concentrations of dissolved uranium and chromium. The sediments washed in campaign 4 contained much lower concentrations of uranium and chromium than other soils that were washed, so we cannot unequivocally attribute the lower concentrations observed in the solution to the shorter contact time.

TABLE 20. Process Waste-Water Chemical Analysis (mg/L) from Field Tests

Sample	B08MN7	B08NM3	B09760
Field Test	1	2	4
Al	0.1	0.2	0.44
Al (ICP-MS)	0.268	0.325	0.06
B	3	3	0.50
Ba	0.03	0.03	0.06
Ba (ICP-MS)	0.038	0.041	0.055
Ca	7.8	7.5	23.7
Cr	0.063	0.092	<0.002
Cr (ICP-MS)	0.075	0.098	0.005
Cu	0.012	0.014	0.05
Cu (ICP-MS)	0.014	0.015	0.019
Fe	0.44	0.43	0.08
K	2.5	1.9	3.8
Mg	1.4	0.91	29.7
Mg (ICP-MS)	1.37	0.99	29.0
Mn	0.007	0.008	<0.001
Na	90	114	10.9
Si	3.2	3.2	3.7
Sr	0.035	0.032	0.10
Sr (ICP-MS)	0.035	0.032	0.10
Zr	0.016	0.012	<0.001
Zr (ICP-MS)	<0.0005	0.002	<0.001
U (ICP-MS)	24.2	34.4	0.99
^{238}U (ICP-MS)	24.2	34.4	NA[(a)]
^{235}U (ICP-MS)	0.184	0.297	NA
pH	8.07	8.19	7.60
F	0.79	3.2	<1
Cl	5.4	3.6	72.9
NO_3	3.9	4.4	3.0
SO_4	24.1	32.3	14.9
HCO_3	175.0[(b)]	210.0[(b)]	85.1
TOC	2.85	3.95	6.3

(a) NA = not analyzed
(b) Calculated value to provide anion-cation balance

TABLE 21. Chemical Analyses of Laboratory Wet-Sieve Rinse Waters

	Mg (mg/L)	Al (mg/L)	Sr (mg/L)	U (mg/L)	Cr (µg/L)	Cu (µg/L)	Zr (µg/L)	Ba (µg/L)
Campaign 1								
B08MN6 Composite Feed	1.3	0.20	0.01	19.7	46	19	6.0	89
B08MN8 6 in.	1.9	0.27	0.04	5.08	73	29	3.7	26
B08MN9 1-6 in.				Not Available				
B08MP0 2 mm - 1 in.	1.5	0.11	0.03	7.58	9.7	9.5	<0.5	21
B08MP1 0.425 - 2 mm	0.93	0.20	0.02	29.4	49	15	3.9	24
B08MP1 attrition scrub	1.5	0.30	0.04	14.7	7.	30	<0.5	44
B08MN7 <0.425 mm				Not Available				
Campaign 2								
B08NM2 Composite Feed	1.2	0.37	0.05	27.6	62	39	22.5	84
B08NM4 >6 in.	1.5	0.36	0.03	9.32	63	23	<0.5	19
B08NM5 1 - 6 in.	0.8	0.62	0.02	16.7	35.2	24.8	12	20
B08NM6 2 mm - 1 in.	2.47	0.09	0.09	36.40	40.1	27.9	4.0	69.9
B08NM7 0.425 - 2 mm	0.8	0.16	0.02	20.00	24.0	16.5	11.9	23.2
B08NM7 attrition scrub	1.5	0.40	0.02	19.70	13.7	51.1	28.7	29.5
B08NM3 <0.425 mm				Not Available				
Campaign 3								
B08NM8 2 mm - 1 in.	0.4	0.19	0.01	0.325	3.7	10.5	0.8	17.7
B08NM9 0.425 - 2 mm	0.7	0.11	0.03	0.462	6.5	10.1	6.2	33.9
Campaign 4								
B09758 Composite Feed	0.79	0.14	0.03	0.008	1.6	16.2	2.0	5.6
B09761 1 - 6 in.	1.15	0.04	0.04	0.076	1.1	12.6	<0.5	5.6
B09762 2 mm - 1 in.	0.66	0.13	0.02	0.012	2.0	58.6	2.0	18.4
B09763 0.425 - 2 mm	0.34	0.12	0.01	0.003	1.6	41.0	3.7	3.7
B09759 <0.425 mm	0.97	0.22	0.02	0.023	2.2	51.2	5.4	8.8

In order to address the dissolution of uranium and selected trace metals as a function of time, some of the leftover moist <0.425 mm-material stored from campaign 2 (B08NM3) was contacted with deionized water for 30 days. The ratio 20.18 g dry sediment/100.11 mL deionized water (0.202 g/mL) is very close to the sediment to water ratio used in lab wet screening. After contact times of 15 min, 1, 9, and 30 days a 10-mL aliquot of solution was removed, filtered through 0.45-μm membranes and analyzed for selected metals. The remaining slurry was slowly agitated by end-over-end tumbling during the entire time. Table 22 shows the measured solution concentrations of selected metals that appear to leach from the sediment. The initial measurement of these metals in water separated from the fines collected in the Frac tank is also shown for comparison.

The laboratory leach study of <0.425-mm material shown in Table 22 does not show consistent patterns for metals concentrations versus time. Only Ba shows a consistent trend where concentration drops with time. Uranium also appears to continue dissolving with time. The data suggest that suspended colloids with sizes <0.45 μm may be dominating the measured concentrations and at any given time either the colloid distribution is quite variable or the filtering efficiency is variable. We can state that the laboratory leachate data are similar to the chemical composition of spent process water and that significant concenetrations of uranium can be found to pass through 0.45-μm filters for conditions expected during field-scale physical soil washing oeprations.

There is a slight change (see Table 20) in the major cation and anions found in the spent process waters between campaigns 2 and 4. The spent process waters from the first two campaigns are sodium-bicarbonate-sulfate dominated while the campaign 4 water is magnesium-calcium-chloride-bicarbonate dominated. The feed water was not changed between campaigns so the spent waters likely become dominated with salts dissolved from the sediments that were washed.

TABLE 22. Leaching vs. Time for Selected Metals from <0.425 mm Campaign 2 Fines (B08NM3)

Contact Time	Mg (mg/L)	Al (mg/L)	Sr (mg/L)	U (mg/L)	Cr (μg/L)	Cu (μg/L)	Zr (μg/L)	Ba (μg/L)
15 min	2.04	6.16	0.012	7.7	125	600	19	631
1 day	1.00	0.44	0.054	16.6	<1	24	1	387
9 day	1.34	4.27	0.018	16.9	54	195	106	84
30 day	2.53	3.80	0.036	4.29	52.4	109	28.5	74
Field Sample ≈45 day	0.99	0.32	0.032	34.4	98	15	2	41

The water analyses for the laboratory wet sieved sediments also were analyzed by ICP-MS for selected metals. In general, the waters generated in laboratory wet-sieving activities (see Table 21) have similar chemical compositions to the spent process waters from field washing. For campaigns 1 and 2 noticeable U and Cr are leached from the sediment during wet sieving. Concentrations observed in the 0.45-μm filtered waters from the lab are slightly lower than the spent process water from the field, perhaps because these sediments had already been washed once in the field or alternatively because the contact time was smaller.

Table 21 shows that there is not a large decrease in leachable trace metals, such as Cr, Cu, and U, on the various sized sediments in the different field piles from the >6 in. down to the <0.425-mm material, which is surprising. One would expect the coarser particles, because they contain smaller concentrations of metals, would leach much smaller amounts of contaminants than fine-grained sediment. This suggests that very fine-suspended colloids, <0.45 μm, may be present in all the wash waters.

Campaign 4 spent wet sieving waters from laboratory testing contains much less U and Mg than the spent field process water from campaign 4, but we have no explanation as yet. The composite feed material that was first contacted with water during the laboratory wet sieving leached the least uranium even though the other samples from the various piles had already been washed once in the field.

Gerber et al. (1991) performed bench-scale soil washing tests on sediment from the 300 Area North Process Pond for slightly longer time periods ($\sim$1 h vs. our $\sim$30 min) at a water-to-solids ratio of 5:1 (similar to our $\sim$4:1) but found no measurable U leaching into the water. Gerber et al. (1991) did find some Cr and Cu leaching. Their analytical technique, ICP, is not the best technique for analyzing low concentrations of trace metals in solution and their overall mass balance on U (sum of all U mass in sieved particle sizes plus water compared to bulk soil) was only 55%. Therefore, the discrepancy in our data (showing significant U leaching into wash waters) and Gerber et al. (1991) may be explained by challenging analytical problems for ICP in Gerber et al.'s work. Alternatively, perhaps the soluble uranium in the sediments is associated with the green and white agglomerates that may not have been present in materials used by Gerber et al. (1991).

The data in Tables 20 through 22 should be compared with water treatment goals to design an applicable treatment scheme if necessary. The data suggest that very fine particles, <0.45-μm, may be present such that coagulation treatment followed by filtration may be useful. If U and to a lesser extent Cr remain in solution after coagulation/filtration treatment, an oxidation-reduction process to reduce U(VI) and Cr(VI) to U(IV) and Cr(III) species might prove beneficial.

CONCLUSIONS AND RECOMMENDATIONS

The work reported in this document will help WHC interpret its 300 Area North Process pond physical soil washing tests performed in June and September 1993.

The moisture content of the coarse material (>1 in.) shipped from the piles generated during the field washing were quite low (<2.5%) but variable. Material from the 1-in. to 2-mm piles contained 2.3 to 8.8% moisture dependent on campaign. The 2-mm to 0.425-mm piles contained 18 to 22% moisture. Moisture contents, especially for coarse sands and gravels, are dependent on the time allowed to elapse between soil washing and sample collection. Field log books should be consulted to evaluate the elapsed time between soil washing and sample collection to best determine the usefulness of the moisture content data reported in this document.

Dry bulk density calculations were inaccurate because containers were not filled completely. The plastic bags do not conform to the cylindrical shape of the 5-gal and 1-gal paint buckets used. Calculated values for 1-gal buckets were especially biased. Dry bulk densities for field piles likely are 1.8 to 2.0 g/cm^3 for coarse piles (material >1 in.), 1.6 to 1.8 g/cm^3 for piles 2 mm to 1 in., and 1.4 to 1.6 g/cm^3 for piles 0.425 to 2 mm based on experience.

The feed material for campaign 4 contained considerably more material larger than 2 in. and considerably less material smaller than 2 mm than campaigns 1 and 2. The feed materials are classified as shown in Table 23.

TABLE 23. Feed Material Classification (%)

	Campaign 1	Campaign 2	Campaign 4
Cobbles (>2 in.)	47.0	36.1	63.2
Gravel (>2 mm)	27.7	40.6	32.4
Sand (>0.075 mm)	21.8	21.2	3.6
Fines (<0.075 mm)	3.5	3.1	0.8

In campaigns 1 and 2, after soil washing all piles created (see Figure 1) contain up to 15% to 20% by weight finer grained material that should have been carried to the next smaller grain-sized pile. This is likely due to incomplete breakdown of agglomerated green material and suggests that more vigorous washing and/or attrition scrubbing would be beneficial.

The trace metal and γ ray content of the sieved material showed an unexpected bimodal distribution for sediments from campaigns 1 and 2. The particle sizes 1 to 2 mm and 2 to 9.5 mm contain a second peak concentration for metals such as Cr, Ni, Cu, Zr, Ag, Sn, Pb, and U. There is no bimodal distribution in the sieved sediments from campaign 4. Visual inspection of the sieved material from campaigns 1 and 2 showed distinct agglomerates of material with either greenish or whitish hues. This material contains high concentrations of the above metals. The green material is predominately calcium carbonate (calcite) and the white material is predominately aluminum hydroxide (gibbsite). Micron-sized metal-enriched crystallites appear to be embedded within the agglomerates.

None of the sediments showed signs of elevated activity for other gamma-emitting isotopes besides ^{238}U and ^{235}U. The uranium activity in campaign 2 sediments were slightly higher than past analyses of various samples from the process pond, but the activities found in campaign 1 and 4 sediments are similar to past studies. Past studies did not identify the bimodal concentration distribution versus particle size.

A comparison of the calculated ^{238}U concentration in the various piles generated in each soil washing campaign with the 370 pCi/g ^{238}U clean-up goal shows that campaign 4 feed materials and all size fractions readily met the goal and contaminant concentrations in the 2-mm to 0.425-mm fraction were reduced by a factor of 4 after processing. For campaigns 1 and 2, ^{238}U concentrations off the second vibrating screen (>0.425 to <2 mm) were near to, or exceeded, test performance levels. The apparent cause of the high ^{238}U concentrations in the 0.425-mm to 1-in. material is the green and white agglomerates.

The white material contains very high concentrations of Al and slightly elevated levels of U. Crystalline solids identified in the white material include gibbsite [$Al(OH)_3$] and small amounts of boehmite [AlOOH] and bayerite [$Al(OH)_3$]. Traces of calcite [$CaCO_3$] and uranium (VI) bearing oxides are possibly present. The green material is highly enriched in copper, zirconium, uranium, and calcium and enriched in aluminum and magnesium. The bulk of the crystalline material identified in the green material is calcite, and there are minor amounts of gibbsite also present. Despite the high concentrations of Cu and U no crystalline products were positively identified in crushed specimens.

Attrition scrubbing was performed on the 0.425- to 2-mm material from campaigns 1 and 2. The scrubbing generated about 13 to 15% more fines (<0.425 mm) and lowered the ^{238}U content of the remaining >0.425-mm material to 47 ± 1 pCi/g, which is significantly below the starting activities of 158 to 210 pCi/g (based on gamma counting data).

Based on the data collected on the feed materials and field washed sediments from the various piles, we offer the following recommendations. The operating parameters could be changed such that the first vibrating screen rejects all particles larger than 9.5 mm, as opposed to larger than 1 in. Because there appears to be a large drop in uranium activity in particles above 9.5 mm size, such a preliminary cut would allow the washing process to concentrate on the "problem" sized material. The trommel could be optimized to break up the 1- to 9.5-mm sediments that contain the green and white contaminant-enriched agglomerates. Alternatively, attrition scrubbing of <9.5-mm material could be performed prior to sending the material into the trommel. Finally, the agglomerates might easily be broken up by the addition of dispersing agents or the addition of acid to dissolve the calcite and gibbsite that constitute the bulk of the agglomerates.

The spent process water from campaigns 1 and 2 appears to contain significant quantities of dissolved uranium (25 to 35 mg/L, which is equivalent to 8,700 to 12,200 pCi/L). Dissolved Cr concentrations also reach 50 to 100 μg/L (ppb). Based on measurements of the spent waters from the laboratory wet sieving that show little drop in observed concentrations for water used to wash fines (<0.425 mm) up to cobbles/boulders (>2 in.), we suspect that much of the "dissolved" material is actually colloidal particles smaller than 0.425 μm. We recommend that spent wash water be treated to coagulate colloids. If coagulation is not successful, then reduction processes to reduce U(VI) and Cr(VI) to U(IV) and Cr(III) would likely prove useful.

REFERENCES

Dennison, D. I., D. R. Sherwood, and J. S. Young. 1989. Status Report on Remedial Investigation of the 300 Area Process Ponds. PNL-6442, Pacific Northwest Laboratory, Richland, Washington.

DOE. 1993. 300-FF-1 Physical Separations CERCLA Treatability Test Plan. DOE\RL 92-21, Rev. 1. Department of Energy, Richland Field Office, Richland, Washington.

DOE. 1992. Phase 1 Remedial Investigation Report for the 300-FF-1 Operable Unit. DOE-RL-92-43, Department of Energy, Richland Field Office, Richland, Washington.

Gerber, M. A., H. D. Freeman, E. G. Baker, and W. F. Riemath. 1991. Soil Washing: A Preliminary Assessment of Its Applicability to Hanford. PNL-7787, Pacific Northwest Laboratory, Richland, Washington.

Serne, R. J., C. W. Lindenmeier, P. K. Bhatia, and V. L. LeGore. 1992. Contaminant Concentration vs. Particle Size for 300 Area North Process Pond Samples. WHC-SD-EN-TI-049, Rev. 0, (PNL-8401). Westinghouse Hanford Company, Richland, Washington.

Young, J. S., and J. S. Fruchter. 1991. Addendum to Data Compilation Task Report for the Source Investigation of the 300-FF-1 Operable Unit Phase 1 Remedial Investigations, EMO-1026, Environmental Management Operations, Pacific Northwest Laboratory, Richland, Washington.

Young, J. S., R. M. Fruland, and J. S. Fruchter. 1990. Data Compilation Task Report for the Source Investigation of the 300-FF-1 Operable Unit Phase 1 Remedial Investigation. PNL-7241, Pacific Northwest Laboratory, Richland, Washington.

APPENDIX A

RAW DATA FOR MOISTURE CONTENTS AND PARTICLE-SIZE DISTRIBUTIONS

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APPENDIX A

RAW DATA FOR MOISTURE CONTENTS AND PARTICLE-SIZE DISTRIBUTIONS

The following tables and copies of spreadsheet outputs contain all the primary data (mostly weights of various aliquots) for the 19 samples that contained solids shown in Table 2. The primary data allow moisture content calculations for as-received samples and some moisture contents for air-dry segments, and the data also show how the percentages of each size range (see Table 1) were calculated. Finally, the appendix shows a mass balance check to reconstruct the as-received wet weight from all the final aliquots for each sample. In all cases, the mass balance exceeded 98% and was generally between 100 ± 0.5%.

Sample: B08MN6

Description: Composite (Feed)
Bucket Size: 5 gallon
Full Bucket Weight (wet g): 22105
Empty Bucket Weight (dry g): 2312
Soil (wet g): 19793

Volume of Sample: 3/4 full

Moisture Content Data

As Received Sample	Pan Tare (g)	Pan + Wet Soil (g)	Wet Soil (g)	Pan + Dry Soil (g)	Dry Soil (g)	Moisture Content (%)
1	22.01	70.04	48.03	61.86	39.85	20.53
2	22.08	60.53	38.45	52.43	30.35	26.69
3	22.13	54.70	32.57	47.56	25.43	28.08
Average Moisture Content (%) = 25.10 ± 4.02						
<2 mm prior to sieving						
1	31.04	87.29	56.25	79.68	48.64	15.65
2	31.15	91.35	60.20	83.34	52.19	15.35
Average Moisture Content (%) = 15.50 ± 0.21						

Wet Sieving Data

Sieve Size	Pan #	Pan or Bag Tare (g)	Sieve Tare (g)	Wet Soil + Tare (g)	Dry Soil + Tare (g)	Soil Weight Dry (g)	Fraction Sieved	Particle Size Distribution (%)
2 in.	Flat	849.00	N/A	8891.00	8824.00	7975.00	1.	47.03
1 in.	2A	249.62	N/A	2538.00	2529.74	2280.12	1.	13.45
0.5 in.	3A	247.83	N/A	1644.28	1626.71	1378.88	1.	8.13
9.5 mm	3	246.18	N/A	823.49	805.29	559.11	1.	3.30
2 mm	6	250.27	471.86	1257.46	1215.10	492.97	1.	2.91
1 mm	7	249.72	460.85	752.82	736.31	25.74	0.0657	2.31
0.425 mm	11	247.91	407.98	823.37	767.40	111.51	0.0657	10.01
0.212 mm	8	244.55	390.02	739.69	699.29	64.72	0.0657	5.81
0.150 mm	10	250.28	379.72	660.01	643.98	13.98	0.0657	1.26
0.075 mm	5	248.84	299.53	601.29	574.03	25.66	0.0657	2.30
<0.075 mm	2	609.42	N/A	--	648.35	38.93	0.0657	3.49
							Total	100.00

Sample: B08MN6

Mass Balance

	Wet (g)	Dry (g)	Moisture Content (%)
Total Available	19793		
Used For			
Moisture Contents	119.05	95.63	25.10
Archive	0	0	--
Stuck on bucket	(14.90)	11.91	assume 25.10
Stuck on rinse containers	99.83	--	--
Wet Sieve (coarse)	12839.49*	12686.08	1.21
Wet Sieve (fines)	324.02	280.54	15.50
Moisture Contents (fines)	116.45	100.83	15.50
Not Used			
Coarse	0	0	--
Fines	4609	3990.48	15.50

Start: 19793 wet g   Accounted for: 18122.74*   % Accounted for = 91.6*

	Dry Weight (g)
Fines	
Sieved	280.54
Not Sieved	3990.52
Total	4271.06
Fraction Sieved: 0.0657	

* Coarse material dried some prior to sieving. Wet weight bias low by undetermined amount.

Sample: B08MN8

Description: >6 inch pile
Bucket Size: 5 gallon
Full Bucket Weight (wet g): 26214
Empty Bucket Weight (dry g): 2302
Soil (wet g): 23912

Volume of Sample: large rocks

Moisture Content Data

As Received Sample	Pan Tare (g)	Pan + Wet Soil (g)	Wet Soil (g)	Pan + Dry Soil (g)	Dry Soil (g)	Moisture Content (%)
Too large rock - could not do moisture content						

Wet Sieving Data

Sieve Size	Pan #	Pan or Bag Tare (g)	Sieve Tare (g)	Wet Fraction + Container	Dry Fraction + Container	Soil Weight	Soil Fraction (%)
>2 inch	6	611.27	--	24426	24245	23633.73	99.71
2 inch	--	2932	--	--	--	--	0.00
1 inch	--	14.36	--	--	--	--	0.00
0.5 inch	--	14.36	--	--	--	--	0.00
9.5 mm	--	--	639.87	--	--	--	0.00
2 mm	6	248.21	471.86	732.76	725.61	5.54	0.02
1 mm	7	249.72	460.85	722.24	714.39	3.82	0.02
0.425 mm	11	247.91	407.98	688.58	675.10	19.21	0.08
0.212 mm	8	244.55	390.02	661.20	647.51	12.94	0.05
0.150 mm	10	250.28	379.72	640.75	632.73	2.73	0.01
0.075 mm	5	248.84	299.53	567.92	555.00	6.63	0.03
<0.075 mm	3	605.87	N/A	--	623.67	17.80	0.08
						Total %	100.00

Sample: B08MN8

Mass Balance

	Wet (g)	Dry (g)	Moisture Content (%)
Total Available	23912		
Used For			
Moisture Contents	0	0	0
Archive	0	0	0
Stuck on bucket	0	0	0
Stuck on rinse containers	0	0	0
Wet Sieve	23918.71	23702.40	0
Not Used			
Coarse	0	0	0
Fines	0	0	0

Start: 23913 g wet Accounted for: 23919 g wet % Accounted for: 100.03

Sample: B08MN9

Description: 1 to 6 inch pile
Bucket Size: 5 gallon
Full Bucket Weight (wet g): 28761
Empty Bucket Weight (dry g): 2352
Soil (wet g): 26409

Volume of Sample: 3/4 full

Moisture Content Data

Pan #	Pan Tare (g)	Pan + Soil Wet Weight (g)	Pan + Soil Dry Weight (g)	Soil Wet Weight (g)	Soil Dry Weight (g)	Moisture Content (%)
2	247.93	599.44	596.31	351.51	348.38	0.90
3	248.97	568.41	564.2	319.44	315.23	1.34
9	247.92	329.92	329.77	82	81.85	0.18
Average Moisture Content % = 0.81 ± 0.59						

Wet Sieving Data

Sieve Size	Pan #	Pan or Bag Tare (g)	Sieve Tare (g)	Wet Fraction + Container	Dry Fraction + Container	Soil Weight	Soil Fraction (%)
2 inch	--	2932	N/A	--	24415.00	21483.00	86.697
1 inch	--	14.36	N/A	--	3003.26	2988.90	12.062
0.5 inch	--	14.36	N/A	--	148.41	134.05	0.541
9.5 mm	--	--	639.87	--	647.21	7.34	0.030
2 mm	6	248.21	471.86	734.63	723.79	3.72	0.015
1 mm	7	249.72	460.85	746.90	714.24	3.67	0.015
0.425 mm	11	247.91	407.98	712.60	688.41	32.52	0.131
0.212 mm	8	244.55	390.02	706.98	679.08	44.51	0.180
0.150 mm	10	250.28	379.72	654.50	641.60	11.60	0.047
0.75 mm	5	248.84	299.53	591.61	570.90	22.53	0.091
<0.075 mm	--	28.01	--	--	75.48	47.47	0.192
						Total %	100.00

Sample: B08MN9

Mass Balance

	Wet (g)	Dry (g)	Moisture Content (%)
Total Available	26409		
Used For			
Moisture Contents	752.95	745.46	0.81
Archive	816.32	814.58	0.21
Stuck on bucket	--	1.31	--
Wet Sieve (coarse)	(24665.86)	24613.29	assume 0.21
Wet Sieve (fines)	(167.36)	166.02	assume 0.81
Not Used	0	0	--

Start: 26409 g wet   Accounted for: 26403.8 g wet   % Accounted for: 99.98

Sample: B08MPO

Description: 1 inch to 2.0 mm
Bucket Size: 1 gallon
Full Bucket Weight (wet g): 5916
Empty Bucket Weight (dry g): 375.83
Soil (wet g): 55540.17

Volume of Sample: 3/4 full

Moisture Content Data

Pan #	Pan Tare (g)	Pan + Soil Wet Weight (g)	Pan + Soil Dry Weight (g)	Soil Wet Weight (g)	Soil Dry Weight (g)	Moisture Content (%)
1	22.01	58.58	57.27	36.57	35.26	3.72
2	21.97	76.43	75.31	54.46	53.34	2.10
3	21.79	66.84	65.17	45.05	43.38	3.85
Average Moisture Content % = 3.22 ± 0.98						

Wet Sieving Data

Sieve Size	Pan #	Pan or Bag Tare (g)	Sieve Tare (g)	Wet Fraction + Container	Dry Fraction + Container	Soil Weight	Soil Fraction (%)
2 inch	--	2932	--	--	--	0	0
1 inch	--	14.36	--	--	--	0	0
0.5 inch	7	250.51	N/A	--	2350.84	2100.33	40.04
9.5 mm	2	248.02	N/A	--	1522.31	1274.29	24.29
2 mm	6	248.21	471.86	2790.80	2539.38	1819.31	34.69
1 mm	7	249.72	460.98	754.88	740.70	30.13	0.57
0.425 mm	11	247.91	407.98	667.83	659.55	3.66	0.07
0.212 mm	8	244.55	390.02	644.18	636.99	2.42	0.05
0.150 mm	10	250.28	379.72	636.78	630.99	0.69	0.01
0.075 mm	5	248.84	299.53	556.40	549.50	1.13	0.02
<0.075 mm	6	28.18			41.38	13.20	0.25
						Total	99.999

Sample: B08MP0

Mass Balance

	Wet (g)	Dry (g)	Moisture Content (%)
Total Available	5540.17	--	--
Used For			
Moisture Contents	136.08	131.98	3.22
Archive	69.12	68.06	1.56
Stuck on bucket	0	0	--
Wet Sieve (coarse)	(3427.26)	3374.62	assume 1.56
Wet Sieve (fines)	(1899.74)	1870.54	assume 1.56
Not Used	0	0	

Start: 5540.17 g wet   Accounted for: 5532.20 g wet   % Accounted for: 99.86

Sample: B08MP1

Description: 0.425 to 2 mm pile
Bucket Size: 1 gallon
Full Bucket Weight (wet g): 4196
Empty Bucket Weight (dry g): 368.14
Soil (wet g): 3827.86

Volume of Sample: 7/8 full

Moisture Content Data

Sample	Pan Tare (g)	Pan + Soil Wet Weight (g)	Pan + Soil Dry Weight (g)	Soil Wet Weight (g)	Soil Dry Weight (g)	Moisture Content (%)
1	21.95	43.87	40.51	21.92	18.56	18.10
2	21.93	38.33	35.79	16.4	13.86	18.33
3	21.83	39.56	36.85	17.73	15.02	18.04
Average Moisture Content % = 18.16 ± 0.15						

Sample was split into three aliquots to perform
a. wet sieving
b. dry sieving
c. attrition scrubbing

Weights (wet g)

a.	1580.70
b.	686.96
c.	1425.69
Archive	54.69
Moisture content	56.06

Total Start (wet g) 3827.86 Total of aliquots (wet g) 3804.09 % Accounted for 99.38

Sample: B08MP1

Wet Sieve Aliquot: Start - 1580.70 g wet End - 1341.84 g dry % Accounted for - 100.30
1585.52 g wet
calculated

Wet Sieving Data

Sieve Size	Pan #	Pan or Bag Tare (g)	Sieve Tare (g)	Wet Fraction + Container	Dry Fraction + Container	Soil Weight
Aliquot 1						
2 mm	6	248.21	471.86	750.83	738.76	18.69
1 mm	7	249.72	460.85	852.290	777.73	67.16
0.425 mm	11	247.91	407.98	1049.15	951.38	179.39
0.212 mm	8	244.55	390.02	717.53	692.61	58.04
0.150 mm	10	250.28	379.72	639.75	632.36	2.36
0.075 mm	5	248.84	299.53	556.44	549.913	1.54
Aliquot 2						
2 mm		248.21	471.86	745.98	735.62	15.55
1 mm		249.72	460.85	983.90	915.40	204.83
0.425 mm		247.91	407.98	1384.65	1195.68	539.79
0.212 mm		244.55	390.02	767.65	732.21	97.64
0.150 mm		250.28	379.72	643.63	634.64	4.64
0.075 mm		248.84	299.53	561.05	552.63	4.26
Combined Sievings						
<0.075 mm	6B	611.21	--	--	643.06	31.85

Totals For Wet Sieving

Sieve Size	Dry Weight (g)	Particle Size (%)
2 mm	34.24	2.55
1 mm	271.99	20.27
0.425 mm	835.28	62.25
0.212 mm	155.68	11.60
0.150 mm	7.00	0.52
0.075 mm	5.80	0.43
<0.075 mm	31.85	2.37
Total	1341.84	100.00

9413273.0075

Sample: B08MP1

Dry Sieve Aliquot: Start - 686.96 g wet End - 589.00 g dry % Accounted for - 101.31
695.96 g wet
calculated

Dry Sieving Data

Sieve Size	Tare Container (g)	Container + Dry Soil (g)	Dry Soil Weight (g)	Soil Fraction (%)
2 inch			0	0
1 inch			0	0
0.5 inch			0	0
9.5 mm			0	0
2 mm	14.16	18.05	3.89	0.66
1 mm	14.08	78.28	64.20	10.90
0.425 mm	14.24	403.14	388.90	66.03
0.212 mm	14.25	134.21	119.96	20.37
0.150 mm	14.18	18.32	4.14	0.70
0.075 mm	14.11	17.16	3.05	0.52
<0.075 mm	14.17	19.03	4.86	0.83
		Total	589.00	100.01

Sample: B08MP1

Attrition Aliquot: Start - 1425.69 g wet End - 512.4 g dry % Accounted for - 102.50
Used only wet g 590.74 605.5 wet calculated
∴ unused wet g 834.95

Wet Sieving Data

Sieve Size	Pan #	Pan or Bag Tare (g)	Sieve Tare (g)	Wet Fraction + Container	Dry Fraction + Container	Soil Weight	Soil Fraction (%)
2 inch		2932					
1 inch		14.36					
0.5 inch		14.36					
9.5 mm		--	639.87				
2 mm	6	248.21	471.86	727.80	722.18	2.11	0.41
1 mm	7	249.72	460.85	784.67	761.38	50.81	9.92
0.425 mm	11	247.91	407.98	1066.89	973.56	317.67	61.99
0.212 mm	8	244.55	390.02	734.67	701.59	67.02	13.08
0.150 mm	10	250.28	379.72	641.49	632.52	2.52	0.49
0.075 mm	5	248.84	299.53	558.56	550.55	2.18	0.43
<0.075 mm	3	605.93	--	--	676.06	70.13	13.69
					Total %	512.44	100.01

Sample: B08MN7

Description: <0.425 mm Slurry
Bucket Size: Large Carbuoy
Full Bucket Weight (wet g): 19709
Empty Bucket Weight (dry g): 2124
Soil + Water (wet g): 17585

Volume of Sample: 3/4 full

Moisture Content Data

Sample	Pan Tare (g)	Pan + Soil Wet Weight (g)	Pan + Soil Dry Weight (g)	Soil Wet Weight (g)	Soil Dry Weight (g)	Moisture Content (%)
1	30.71	128.19	103.79	97.48	73.08	33.388
2	31.3	113.3	92.63	82	61.33	33.702
3	31.56	92.3	77.09	60.74	45.53	33.406
Average Moisture Content % = 33.50 ± 0.18						

Decanted excess water off settled solids placed in bottle

Bottle Tare 1426 g Full of Water 13822 g Weight of Water 12396

Remaining wet soil placed in bags and homogenized

Tare 662 g Bags Empty 28.8 g Bags Full + Tare 5753 g Weight of Wet Soil 5062.2 g

Soil has moisture content shown above, therefore dry weight of soil = 3791.91 g
water in soil = 1270.29 g

For wet sieving took 383.60 g wet = 287.34 g dry

Sieve Size	Pan #	Pan or Bag Tare (g)	Sieve Tare (g)	Wet Fraction + Container	Dry Fraction + Container	Soil Weight	Soil Fraction (%)
2 mm	6	248.21	471.86	729.27	722.10	2.03	0.710
1 mm	7	249.72	460.85	720.08	713.08	2.51	0.878
0.425 mm	11	247.91	407.98	676.57	668.96	13.07	4.574
0.212 mm	8	244.55	390.02	929.46	859.94	225.37	78.878
0.150 mm	10	250.28	379.72	658.57	647.27	17.27	6.044
0.075 mm	5	248.84	299.53	572.78	562.06	13.69	4.791
<0.075 mm	7	618.05	N/A		629.83	11.78	4.123
					Total %	285.72	100.00

Sample: B08MN7

Mass Balance

	Wet (g)	Dry (g)	Moisture Content (%)
Total Available	17585	--	--
Used For			
Moisture Contents	240.22	179.94	33.50
Wet Sieve	383.60	287.34	33.50
Excess Water Decanted	12396	--	--
Wet Soil Not Used	4438.4	--	--

Start: 17585 g Accounted For 17458.20 % Accounted For = 99.28

Water in Slurry (g)

Excess Decanted	12396
Water in Moisture Samples	60.28
Water in Wet Sil	1270.29
	13626.57

Dry Weight of Soil (g)

Moisture content	179.94
Bulk Sample	3791.91
	3971.85

Solids Content of Slurry ≈ 292 g/ℓ

Sample: B08NM2

Description: Composite (Feed)
Bucket Size: 5 gallon
Full Bucket Weight (wet g): 23812
Empty Bucket Weight (dry g): 2362
Soil (wet g): 21450

Volume of Sample: 3/4 full

Moisture Content Data

Sample	Pan Tare (g)	Pan + Soil Wet Weight (g)	Pan + Soil Dry Weight (g)	Soil Wet Weight (g)	Soil Dry Weight (g)	Moisture Content (%)
1	21.99	67.09	58.48	45.1	36.49	23.60
2	22	65.78	54.84	43.78	32.84	33.31
3	21.94	59.24	51.84	37.3	29.9	24.75
Average Moisture Content % = 27.22 ± 5.31						

Wet Sieving Data

Sieve Size	Pan #	Pan or Bag Tare (g)	Sieve Tare (g)	Wet Fraction + Container	Dry Fraction + Container	Dry Soil (g)	Dry Soil From Material Stuck on Bucket	Fraction Sieved	Total Dry Soil Weight	Soil Fraction (%)
2 inch	Flat Pan	849	N/A	8254.00	8225.00	7376.00	0	1	7376.00	38.28
1 inch	2A	249.62	N/A	3334.35	3309.85	3060.23	0	1	3060.23	15.88
0.5 inch	3A	247.83	N/A	2423.91	2398.25	2150.42	31.31	1	2181.73	11.32
9.5 mm	3	246.18	N/A	959.57	942.78	696.60	21.63	1	718.23	3.73
2 mm	6	248.21	N/A	2030.16	1831.92	1583.71	58.78	1	1642.49	8.52
1 mm	7	249.72	460.85	795.12	746.67	36.10	--	0.054	665.81	3.46
0.425 mm	11	247.91	407.98	781.51	736.83	80.94	--	0.054	1492.81	7.75
0.212 mm	8	244.55	390.02	723.06	687.66	53.09	--	0.054	979.16	5.08
0.150 mm	10	250.28	379.72	658.80	641.56	11.56	--	0.054	213.21	1.11
0.075 mm	5	248.84	299.53	596.29	568.34	19.97	--	0.054	368.31	1.91
<0.075 mm	5	604.21	--	--	635.15	30.94	--	0.054	570.64	2.96
					Total	232.60			19268.62	100.00

Sample: 808NM2

Mass Balance

	Wet (g)	Dry (g)	Moisture Content (%)
Total Available	21450	--	--
Used for Moisture Contents	126.18	99.23	27.22%
Coarse Sieved	--	14866.96	--
Coarse Scraped Off Containers	--	111.72	--
Fines Scraped Off Containers	--	708.62	
Fines <2 mm Available for Sieving	4126*	4126*	Partially dry but not oven dry

Start: 21450 wet g 19912** g does not include all water but is not oven dry either % Accounted for = 92.83*

Sample of Fines Sieved

267.97 g wet 232.60 g oven dry Moisture Content: 15.21%

Total of Fines in Sample

4126* g wet + 708.62 g dry off containers

3581.3 g dry (calculated) + 708.62 g dry = 4289.91 g

Fraction Sieved

232.60 ÷ 4289.91 = .05422

Sample: B08NM4

Description: >6 inch pile
Bucket Size: 5 gallon
Full Bucket Weight (wet g): 22598
Empty Bucket Weight (dry g): 2346
Soil (wet g): 20252

Volume of Sample: 3/4 full

Moisture Content Data

Pan #	Pan Tare (g)	Pan + Soil Wet Weight (g)	Pan + Soil Dry Weight (g)	Soil Wet Weight (g)	Soil Dry Weight (g)	Moisture Content (%)
1	88.11	253.11	252.14	165	164.03	0.59
2	83.14	175.56	175.86	92.42	91.72	0.76
Average Moisture Content % = 0.68 ± 0.12						

Wet Sieving Data

Sieve Size	Pan #	Pan or Bag Tare (g)	Sieve Tare (g)	Wet Fraction + Container	Dry Fraction + Container	Soil Weight	Soil Fraction (%)
2 inch	N/A	N/A	N/A	N/A	N/A	18924	93.72
1 inch	N/A	N/A	N/A	N/A	N/A	1153.00	5.71
0.5 inch	--	--	--	--	--	0.00	0.00
9.5 mm	--	--	639.87	--	--	0.00	0.00
2 mm	6	248.21	471.86	733.82	726.15	6.08	0.03
1 mm	7	249.72	460.85	723.89	715.29	4.72	0.02
0.425 mm	11	247.91	407.98	721.87	693.63	37.74	0.19
0.212 mm	8	244.55	390.02	679.04	654.81	20.24	0.10
0.150 mm	10	250.28	379.72	650.51	636.28	6.28	0.03
0.075 mm	5	248.84	299.53	585.54	560.99	12.62	0.06
<0.075 mm	5	604.16	--	--	619.78	15.62	--
	6	611.27	--	--	623.46	12.19	--
					Total	27.81	0.14
					Total Sieved	20192.49	100.00

Sample: B08NM4

Mass Balance

	Wet (g)	Dry (g)	Moisture Content (%)
Total Available	20252		
Used For			
Moisture Contents	257.42	255.75	0.68
Wet Sieve	--	20192.49	--
Not Used	0	0	0

Start: 20252 g wet   Accounted for: 20449.91 g (some wet/some dry)   % Accounted for: 100.97

Sample: B08NM5

Description: 1 to 6 inch pile
Bucket Size: 5 gallon
Full Bucket Weight (wet g): 31020
Empty Bucket Weight (dry g): 2347
Soil (wet g): 28673

Volume of Sample: 3/4 full

Moisture Content Data

Pan #	Pan Tare (g)	Pan + Soil Wet Weight (g)	Pan + Soil Dry Weight (g)	Soil Wet Weight (g)	Soil Dry Weight (g)	Moisture Content (%)
1	264.52	366.44	335.92	71.92	71.4	0.73
2	264.36	595.3	579.29	330.94	314.93	5.08
3	112.63	212.92	211.68	100.29	99.05	1.25
Average Moisture Content % = 2.35 ± 2.38						

Wet Sieving Data

Sieve Size	Pan #	Pan or Bag Tare (g)	Sieve Tare (g)	Wet Fraction + Container	Dry Fraction + Container	Soil Weight	Soil Fraction (%)
2 inch	1	2932	--	--	27845.00	24913.00	88.43
1 inch		14.36	--	--	2952.00	2937.64	10.43
0.5 inch		14.36	--	--	149.81	135.45	0.48
9.5 mm			639.87	--	652.27	12.40	0.04
2 mm	6	248.21	471.86	732.41	723.78	3.71	0.01
1 mm	7	249.72	460.85	730.20	713.67	3.10	0.01
0.425 mm	11	247.91	407.98	716.25	692.63	36.74	0.13
0.212 mm	8	244.55	390.02	711.94	684.37	49.80	0.18
0.150 mm	10	250.28	379.72	654.13	641.21	11.21	0.04
0.075 mm	3	248.84	299.53	593.15	570.85	22.48	0.08
<0.075 mm	Bag	28.01	--	--	75.49	47.48	0.17
					Total	28173.01	100.00

Sample: B08NM5

Mass Balance

	Wet (g)	Dry (g)	Moisture Content (%)
Total Available	28673	--	--
Used For			
Moisture Contents	503.15	485.38	2.35
Sieved	--	28173.01	--
Not Used	0	0	--

Start: 28673 g wet   Accounted for: 28676.16 g wet   % Accounted for: 100.01

Sample: B08NM6

Description: 1 inch to 2 mm pile
Bucket Size: 1 gallon
Full Bucket Weight (wet g): 1971
Empty Bucket Weight (dry g): 370.15
Soil (wet g): 1600.85

Volume of Sample: 1/2 full

Moisture Content Data

Sample	Pan Tare (g)	Pan + Soil Wet Weight (g)	Pan + Soil Dry Weight (g)	Soil Wet Weight (g)	Soil Dry Weight (g)	Moisture Content (%)
1	22.08	36.97	35.91	14.89	13.83	7.66
2	22.01	45.67	42.87	23.66	20.86	13.42
3	22.03	51.15	49.72	29.12	27.69	5.16
Average Moisture Content % = 8.75 ± 4.24						

Wet Sieving Data

Sieve Size	Pan #	Pan or Bag Tare (g)	Sieve Tare (g)	Wet Fraction + Container	Dry Fraction + Container	Soil Weight	Soil Fraction (%)
2 inch	--	2932	--	--	--	--	--
1 inch	--	14.36	--	--	--	--	--
0.5 inch	9	247.98	--	584.25	576.16	328.18	23.80
9.5 mm	2	248.01	639.87	1194.90	1172.33	284.45	20.63
2 mm	6	248.21	471.86	1578.48	1469.35	749.28	54.35
1 mm	7	249.72	460.78	726.73	719.17	8.67	0.63
0.425 mm	11	247.91	407.88	663.51	656.90	1.11	0.08
0.212 mm	8	244.55	389.95	641.61	635.22	0.72	0.05
0.150 mm	10	250.28	379.68	636.73	630.24	0.28	0.02
0.075 mm	5	248.84	299.51	555.39	548.70	0.35	0.03
<0.075 mm	6	15.08			20.75	5.67	0.41
					Total	1378.71	100.00

Sample: B08NM6

Mass Balance

	Wet (g)	Dry (g)	Moisture Content (%)
Total Available	1600.85	--	--
Used For			
Moisture Contents	67.67	62.38	8.75
Wet Sieved	1500*	1378.71	assume 8.75
Archive	39.69	36.48	8.80
Not Used	0	0	--

Start: 1600.85 g wet Accounted for: 1607.36* g wet % Accounted for: 100.41

*Calculated based on moisture content.

Sample: B08NM7

Description: 0.425 to 2 mm pile
Bucket Size: 1 gallon
Full Bucket Weight (wet g): 4468
Empty Bucket Weight (dry g): 368.51
Soil (wet g): 4099.49

Volume of Sample: 7/8 full

Moisture Content Data

Sample	Pan Tare (g)	Pan + Soil Wet Weight (g)	Pan + Soil Dry Weight (g)	Soil Wet Weight (g)	Soil Dry Weight (g)	Moisture Content (%)
1	21.18	40.21	36.92	19.03	15.74	20.90
2	21.92	43.61	39.73	21.69	17.81	21.79
3	22.12	40.54	37.25	18.42	15.13	21.74
Average Moisture Content % = 21.48 ± 0.50						

Sample was split into three aliquots to perform a. wet sieving
b. dry sieving
c. attrition scrubbing

Weights (wet g)

a.	1630.65
b.	1661.02
c.	684.01
Archive	55.33
Moisture Content	59.14

Total Start (wet g) 4099.49 Total of aliquots (wet g) 4090.15 % Accounted for 99.77

Sample: B08NM7

Wet Sieve Aliquot Start 1630.65 g wet End 1642.29 g calculated % Accounted for 100.71
Aliquot broken into 2 parts each washed separately, splits when dry were combined no particles >9.5 mm found.

Wet Sieving Data

Sieve Size	Pan #	Pan or Bag Tare (g)	Sieve Tare (g)	Wet Fraction + Container	Dry Fraction + Container	Dry Soil Weight
			Sieve #1			
2 mm	6	249.72	471.86	740.03	723.25	1.67
1 mm	7	248.21	460.85	892.48	794.59	85.53
0.425 mm	11	247.91	407.98	1229.11	1033.77	377.88
0.212 mm	8	244.55	390.02	789.11	718.27	83.70
0.150 mm	10	250.28	379.72	643.77	634.68	4.68
0.075 mm	5	248.84	299.53	563.54	552.60	4.23
					Total	557.69
			Sieve #2			
2 mm	6	249.72	471.86	742.46	725.63	4.05
1 mm	7	248.21	460.85	910.27	801.43	92.37
0.425 mm	11	247.91	407.98	1374.93	1156.47	500.58
0.212 mm	8	244.55	390.02	837.12	761.99	127.42
0.150 mm	10	250.28	379.72	645.93	636.82	6.82
0.075 mm	5	248.84	299.53	565.21	554.29	5.92
					Total	737.16
<0.075 mm	5A	604.15	N/A	--	661.20	57.05
					Total	1351.90

Total Wet Sieving

Size	Dry Weight (g)	Particle Size (%)
2 in.	0	0
1 in.	0	0
0.5 in.	0	0
9.5 mm	0	0
2.0 mm	5.72	0.42
1.0 mm	177.90	13.16
0.425 mm	878.46	64.98
0.212 mm	211.12	15.62
0.150 mm	11.50	0.85
0.075 mm	10.15	0.75
<0.075	57.05	4.22

Sample: B08NM7

Dry Sieving Data

Sieve Size	Tare Container (g)	Container + Dry Soil (g)	Dry Soil Weight	Soil Fraction (%)
2 inch	(Not recorded)			
1 inch				
0.5 inch				
9.5 mm				
2 mm			17.20	1.182
1 mm			152.74	10.497
0.425 mm			894.89	61.503
0.212 mm			322.54	22.167
0.150 mm			27.47	1.888
0.075 mm			24.86	1.709
<0.075 mm			15.34	1.054
		Total	1455.04	100.00

Start: 1661.02 g wet End: 1455.04 g dry (1767.58 g calculated wet weight) % Accounted for: 106.42

Sample: BONM7

Attrition/Sieving Data: Starting wet weight - 684.01 g End - 498.26 g dry % Accounted for = 99.67
Used wet weight - 607.32 g (605.29 g wet calculated)
∴ not used 76.69 g

Sieve Size	Pan #	Pan or Bag Tare (g)	Sieve Tare (g)	Wet Sample + Container	Dry Sample + Container	Soil Weight	Soil Fraction (%)
2 mm	6	248.21	471.86	731.69	720.95	0.88	0.177
1 mm	7	249.72	460.85	798.10	761.05	50.48	10.131
0.425 mm	11	247.91	407.98	1014.27	920.65	264.76	53.137
0.212 mm	8	244.55	390.02	775.95	734.34	99.77	20.024
0.150 mm	10	250.28	379.72	647.54	634.36	4.36	0.875
0.075 mm	5	248.84	299.53	562.78	552.13	3.76	0.755
<0.075 mm	3	605.88	--	--	673.42	67.54	--
	5	604.19	--	--	610.90	6.71	--
					Total	74.25	14.902
					Total Sieved	498.26	
						Total %	100.00

Sample: B08NM3

Description: <0.425 mm Slurry
Bucket Size: Large Carbuoy
Full Bucket Weight (wet g): 32127
Empty Bucket Weight (dry g): 2146
Soil + Water (wet g): 29981

Volume of Sample: 3/4 full

Moisture Content Data

Sample	Pan Tare (g)	Pan + Soil Wet Weight (g)	Pan + Soil Dry Weight (g)	Soil Wet Weight (g)	Soil Dry Weight (g)	Moisture Content (%)
1	31.11	83.75	73.2	52.64	42.09	25.065
2	31.22	90.78	79.49	59.56	48.27	23.389
3	31.44	104.16	89.51	72.72	58.07	25.228
Average Moisture Content % = 24.56 ± 1.02						

Decanted excess water off settled solids placed in bottle

Bottle Tare 1418 g Full of Water 12814 g Weight of Water 11396

Remaining wet soil placed in second container

Container Tare 1747 g Container + Wet Soil 20318 Weight of Wet Soil 18571

Soil has Moisture Content shown above; therefore Dry Weight of Soil = 14904 g
Water in Soil = 3667 g

For wet sieving took 329.24 g wet = 264.32 g dry

Sieve Size	Pan #	Pan or Bag Tare (g)	Sieve Tare (g)	Wet Fraction + Container	Dry Fraction + Container	Soil Weight	Soil Fraction (%)
2 mm	6	248.21	471.86	725.82	720.21	0.14	0.054
1 mm	7	249.72	460.85	716.93	712.22	1.65	0.632
0.425 mm	11	247.91	407.98	687.46	676.48	20.59	7.882
0.212 mm	8	244.55	390.02	881.70	823.97	189.40	72.500
0.150 mm	10	250.28	379.72	667.78	654.68	24.68	9.447
0.075 mm	5	248.84	299.53	577.10	565.52	17.15	6.565
<0.075 mm	6	611.25			618.88	7.63	2.921
					Total	261.24	100.00

Sample: B08NM3

Mass Balance

	Wet (g)	Dry (g)	Moisture Content (%)
Total Available	29981	--	--
Used For			
Moisture Contents	184.92	148.43	24.56
Wet Sieve	329.24	261.24	--
Excess Water Decanted	11396	--	--
Wet Soil not used	18057	--	--

Start: 29981 g Accounted for: 29967 g % Accounted for: 99.95

Water in Slurry (g)	
Excess Decanted	11396
Water in Moisture Samples	36.49
Water in Sieved Soil	68.00
Water in Soil not used	3560.37
Total	15060.86
Dry Weight of Soil (g)	
Moisture Content	148.43
Sieved	261.24
Not used	14496.29
Total	14906.29

Solid Content of Slurry ≈ 990 g/ℓ

Sample: B08NM8

Description: 1 inch to 2 mm pile
Bucket Size: 1 gallon
Full Bucket Weight (wet g): 5746
Empty Bucket Weight (dry g): 371.84
Soil (wet g): 5374.16

Volume of Sample: full

Moisture Content Data

Sample	Pan Tare (g)	Pan + Soil Wet Weight (g)	Pan + Soil Dry Weight (g)	Soil Wet Weight (g)	Soil Dry Weight (g)	Moisture Content (%)
1	30.86	199.97	198.43	169.11	167.57	0.92
2	31.43	204.81	203.44	173.38	172.01	0.80
3	30.9	223.91	222.55	193.01	191.65	0.71
Average Moisture Content % = 0.81 ± 0.11						

Pulled 1672.26 - 250.29 tare = 1421.97 g wet soil for sieving

Wet Sieving Data

Sieve Size	Pan #	Pan or Bag Tare (g)	Sieve Tare (g)	Wet Fraction + Container	Dry Fraction + Container	Soil Weight	Soil Fraction (%)
2 inch	--	--	--	--	--	--	--
1 inch	--	--	--	--	--	--	--
0.5 inch	9	248	542.60	2127.87	2086.80	1296.20	92.446
9.5 mm	2	248.02	640.10	976.78	968.87	80.75	5.759
2 mm	6	250.27	471.86	767.44	745.83	23.70	1.690
1 mm	7	249.72	460.85	728.53	710.47	0.75	0.053
0.425 mm	11	247.91	407.98	670.65	655.74	0.09	0.006
0.212 mm	8	244.55	390.02	645.60	634.57	0.10	0.007
0.150 mm	10	250.28	379.72	641.61	629.83	0.04	0.003
0.075 mm	5	248.84	299.53	556.89	548.24	0.02	0.001
<0.075 mm	6	611.27			611.74	0.47	0.034
					Total Sieved	1402.12	100.00

Sample: B08NM8

Mass Balance

	Wet (g)	Dry (g)	Moisture Content (%)
Total Available	5374.16	--	--
Used For			
Moisture Contents	535.50	531.23	0.81
Sieving	1421.97	1402.12	≤1.42
Not Used	not weighed	--	--

Start: 5374.16 g wet Accounted for: N/A % Accounted for: N/A

Sample: B08NM9

Description: 2 to 0.425 mm pile
Bucket Size: 1 gallon
Full Bucket Weight (wet g): 3867
Empty Bucket Weight (dry g): 373.27
Soil (wet g): 3493.73

Volume of Sample: 3/4 full

Moisture Content Data

Sample	Pan Tare (g)	Pan + Soil Wet Weight (g)	Pan + Soil Dry Weight (g)	Soil Wet Weight (g)	Soil Dry Weight (g)	Moisture Content (%)
1	31.06	68.59	63.43	37.53	32.37	15.940
2	31.11	84.36	76.95	53.25	45.84	16.164
3	31.34	88.81	80.82	57.47	49.48	16.147
Average Moisture Content % = 16.08 ± 0.12						

Pulled two aliquots for wet sieving, 268.58 g wet and 796.05 g wet

Sieve Size	Pan #	Pan or Bag Tare (g)	Sieve Tare (g)	Wet Fraction + Container	Dry Fraction + Container	Soil Weight
Aliquot #1						
2 mm	6	248.21	471.86	729.46	721.76	1.69
1 mm	7	249.72	460.85	751.40	733.92	23.35
0.425 mm	11	247.91	407.98	850.71	790.06	134.17
0.212 mm	8	244.55	390.02	724.65	690.56	55.99
0.150 mm	10	250.28	379.72	642.84	632.25	2.25
0.075 mm	15	249.29	299.53	557.73	549.71	0.89
Aliquot #2						
2 mm	6	248.21	471.86	NM	725.04	4.97
1 mm	7	249.72	460.85	NM	797.27	86.7
0.425 mm	11	247.91	407.98	NM	1079.45	423.56
0.212 mm	8	244.55	390.02	NM	782.03	147.46
0.150 mm	10	250.28	379.72	NM	637.64	7.64
0.075 mm	15	249.29	299.53	NM	552.54	3.72
Combined Fines						
<0.075 mm	2	609.38	N/A	NM	611.22	1.84
	6	611.24	N/A	NM	611.90	0.66
	5	604.19	N/A	NM	613.40	9.21
					Total	11.71

Sample: B08NM9

Combined Sieving

Sieve Size	Total Dry Weight	Size (%)
2 mm	6.66	0.74
1 mm	110.05	12.17
0.425 mm	557.73	61.69
0.212 mm	203.45	22.50
0.150 mm	9.89	1.09
0.075 mm	4.61	0.51
<0.075 mm	11.71	1.30
Total	904.10	100.00

Mass Balance

	Wet (g)	Dry (g)	Moisture Content (%)
Total Available	3493.73	--	--
Used For			
Moisture Contents	148.25	127.69	16.08
Sieving	1064.63	904.10	≤17.76
Not Used	Not measured		

Start: 3493.73 g wet   Accounted for: N/A   % Accounted for: N/A

Sample: B09758

Description: Composite (Feed)
Bucket Size: 5 gallon
Full Bucket Weight (wet g): 36737
Empty Bucket Weight (dry g): 2381
Soil (wet g): 34356

Volume of Sample: not recorded

Moisture Content Data (see attached spreadsheet)

Average Moisture Content (%) = 1.04 ± 0.43.
Moisture Samples (3) taken immediately (401.00 g).

Procedure:

Sample was air dried and fines dusted off rocks.
All coarse material >2 mm was sieved and left to air dry.
All fines <2 mm were air dried and a portion was taken for wet sieving.
Two wet sievings of fines were performed.
Dry weights of fines were changed to air dry to be same as coarse condition.
Fraction of fines sieved was adjusted to represent total fines.
% size fraction distribution was calculated and used in main text.

Mass Balance

	Wet (g)	Air Dry (g)	Oven Dry (g)	Moisture Content (%)
Start	34356	--	--	--
Used For				
Moisture Contents	401	~398	397.15	1.04
Coarse Sieved		32443.49	--	--
Fines Total		1479.85	--	--
Fines Sieved		882.91	863.83	≤ 2.21
Fines Not Used		596.94		
Totals	34356	~34321.34		

% Accounted for = 99.90

Fraction Sieved

Coarse >2 mm 100%
Fines <2 mm 59.66%

Correction Factor

Fines Oven Dry to Fines Air Dry = 1.022

Sample: B09758

Particle Size Distribution
(see spread sheet for details)

	Sieved Oven Dry (g)	Sieved Air Dry (g)	Fraction Sieved	Total Air Dry (g)	% Size
>2 in.	--	21438.00	1	21438.00	63.20
>1 in.	--	5682.75	1	5682.75	16.75
>0.5 in.	--	2778.88	1	2778.88	8.19
>9.5 mm	--	788.05	1	788.05	2.32
>2.0 mm	--	1755.81	1	1755.81	5.18
>1 mm	224.97	229.92	.5966	385.39	1.14
>0.425 mm	339.64	347.11	.5966	581.81	1.72
>0.212 mm	89.46	91.43	.5966	153.25	0.45
>0.150 mm	18.89	19.31	.5966	32.36	0.10
>0.075 mm	29.31	29.96	.5966	50.21	0.15
<0.075 mm	161.56	165.12	.5966	276.76	0.82
			Total	33923.27	100.00

9413273.0099

300 AREA SW[redacted] RAW FEED

BUCKET #	B09758					DATE	
SIZE	RAW FEED			WET SOIL	401		
				OVEN-DRY SOIL	397.15		
FULL BUCKET	KG	36.737		MOISTURE	0.97%		
EMPTY BUCKET	KG	2.381					
TOTAL SOIL MATERIAL (g)		34356					
VOL OF BUCKET		5 GAL					
MOISTURE CONTENT							
PAN #	PAN TARE	PAN+SOIL WET WEIGHT	PAN+SOIL DRY WE	SOIL WET WEIGHT	SOIL DRY WEIGHT	MOISTURE PERCENT	
1	31.41	211.96	210.94	180.55	179.53	0.57%	
2	31.26	163.17	161.34	131.91	130.08	1.41%	
3	31.48	120.02	119.02	88.54	87.54	1.14%	
1ST WET SIEVE		WASHED AMOUNT<2MM-		433.82	1.26%		
SIEVE SIZE	PAN #	PAN OR BAG TARE	SIEVE TARE IF APPLICABLE	WET FRACTION + CONTAINER	DRY FRACTION + CONTAINER	SOIL WT.	SOIL FRACTION PERCENT
2 INCH		1741			23179.00	21438.00	62.40%
1 INCH		611.25			6294.00	5682.75	16.54%
0.5 INCH		86.27			2865.15	2778.88	8.09%
9.5 mm		27.18			815.23	788.05	2.29%
2 mm		101.52			1857.33	1755.81	5.11%
1 mm		250.51	460.66	842.61	817.65	106.48	0.31%
0.425 mm		250.23	325.61	801.67	743.92	168.08	0.49%
0.212 mm		248.82	389.96	702.99	680.29	41.51	0.12%
0.150 mm		248.02	379.59	647.63	637.66	10.05	0.03%
0.075 mm		247.96	371.28		635.59	16.35	0.05%
							0.000
		PAN TARE	CONTAINER TARE				
< 0.075		611.25			694.61	83.36	0.24%
RINSE VOLUME (mLs)		4538					
					TOTAL SIEVED	425.83	
					TOTAL RECOVERED	32869.32	95.67%
2ND WET SIEVE		AIR DRIED <2MM WASHED		449.09	1.31%		
SIEVE SIZE	PAN #	PAN OR BAG TARE	SIEVE TARE IF APPLICABLE	WET FRACTION + CONTAINER	DRY FRACTION + CONTAINER	SOIL WT.	
2 INCH							
1 INCH							
0.5 INCH							
9.5 mm							
2 mm							
1 mm		250.51	460.66	857.35	829.66	118.49	0.34%
0.425 mm		250.23	325.61	806.69	747.40	171.56	0.50%
0.212 mm		248.82	389.96	711.24	686.73	47.95	0.14%
0.150 mm		248.02	379.59	645.77	636.45	8.84	0.03%
0.075 mm		247.96	371.28	649.94	632.20	12.96	0.04%
		PAN TARE	CONTAINER TARE				
< 0.075		604.2			682.40	78.20	0.23%
RINSE VOLUME (mLs)		4247.42					
					TOTAL SIEVED	438.00	
					TOTAL RECOVERED	97.53%	
						of lab sieved amount	

Sample: B09761

Description: <6 inches to >1 inch pile
Bucket Size: 5 gallon — Volume of Sample: not recorded
Full Bucket Weight (wet g): 25123
Empty Bucket Weight (dry g): 2381
Soil (wet g): 22742

Moisture Content Data (see attached spreadsheet)

Average Moisture Content (%) = 0.55 ± 0.54

Procedure:

Moisture Samples (3) taken immediately (599.11 g wet).
Rest of sample air dried.
Whole sample was sieved.
Size separates oven dried.
Large scale was not available >2 in. weight calculated to provide 100% mass balance.
See spreadsheet for final particle size distribution.

300 AREA SW B09761 6"-1"

BUCKET #	B09761					DATE	
SIZE	6"-1"			WET SOIL	599.11		
				OVEN DRY SOIL	596.62		
FULL BUCKET	KG	25.123		MOISTURE	0.42%		
EMPTY BUCKET	KG	2.381					
TOTAL SOIL MATERIAL (g)		22742					
VOL. OF BUCKET		5 GAL					
MOISTURE CONTENT							
PAN #	PAN TARE	PAN+SOIL WET WEIGHT	PAN+SOIL DRY WEIGHT	SOIL WET WEIGHT	SOIL DRY WEIGHT	MOISTURE PERCENT	
1	31.26	173.65	172.05	142.39	140.79	1.14%	
2	31.61	184.06	183.38	152.45	151.77	0.45%	
3	30.93	335.2	334.99	304.27	304.06	0.07%	
SIEVE SIZE	PAN #	PAN OR BAG TARE	SIEVE TARE IF APPLICABLE	WET FRACTION + CONTAINER	DRY FRACTION + CONTAINER	SOIL WT.	SOIL FRACTION PERCENT
2 INCH					**	21128.32	92.90%
1 INCH	6	249.37	NA	1023.76	1191.86	942.49	4.14%
0.5 INCH	NA						
9.5 mm	NA						
2 mm	10/1/05	247.96	433.76	692.99	685.93	4.21	0.02%
1 mm	18-1/4	248.02	460.66	729.93	711.41	2.73	0.01%
0.425 mm	40-1/3	248.82	325.61	603.94	586.46	12.03	0.05%
0.212 mm	70-1/2	250.23	389.96	658.84	647.90	7.71	0.03%
0.150 mm	100-1/1	250.51	379.59	638.59	632.36	2.26	0.01%
0.075 mm	200-1/9	249.68	371.28	634.17	626.10	5.14	0.02%
		PAN TARE	CONTAINER TARE				
< 0.075	Large 5	604.26			642.26	38.00	0.17%
					TOTAL SIEVED	22142.89	97.37%
					TOTAL RECOVERED	97%	
CARBOY TARE W/O LID	CARBOY W/ RINSE DI WATER		CARBOY SAMPLE				
1435	4807		BOTTLE TARE	BOTTLE +SOIL		** scale removed calculated	
RINSE VOLUME MLS		3372					
COMPOSITE							

Sample: B09762

Description: 1 inch to 2 mm pile
Bucket Size: 1 gallon
Full Bucket Weight (wet g): 4439
Empty Bucket Weight (dry g): 394
Soil (wet g): 4045

Volume of Sample: not recorded

Moisture Content Data (see attached spreadsheet)

Average Moisture Content (%) = 2.64 ± 0.72

Procedure:

Moisture Samples (3) taken immediately (203.91 g wet)
Rest of sample was air dried.
Whole sample was sieved through 2 mm sieve.
Coarse material >2 mm was wet sieved in two batches
All fines <2 mm were air dried.
All fines wet sieved in one batch.
No corrections were made to oven dry weights.
See spread sheet for details.

Final Results

Size	Oven Dry (g)	%
>0.5 in.	544.78	14.46
>9.5 mm	707.28	18.78
>2 mm	2402.84	63.79
>1 mm	109.95	2.92
>0.425 mm	0.72	0.02
>0.212 mm	0.29	0.01
>0.150 mm	0.08	0.00
>0.075 mm	0.60	0.02
<0.075 mm	0.32	0.01
Total	3766.86	100.00

300 AREA SW B09762 1"-2mm

BUCKET #	B09762			WET SOIL	203.91	
SIZE	1"-2mm			OVEN DRY SOIL	198.68	
FULL BUCKET	KG	4.439		MOISTURE	2.63%	
EMPTY BUCKET	KG	0.394				
TOTAL SOIL MATERIAL (g)		4045				
VOL. OF BUCKET		1 GAL				
MOISTURE CONTENT		PAN+SOIL	PAN+SOIL			
PAN #	PAN TARE	WET WEIGHT	DRY WEIGHT	SOIL WET WEIGHT	SOIL DRY WEIGHT	MOISTURE PERCENT
1	31.12	100.64	98.34	69.52	67.22	3.42%
2	30.93	93.97	92.44	63.04	61.51	2.49%
3	31.11	102.46	101.06	71.35	69.95	2.00%
SIEVE #1						
DRY SIEVED TO 2 mm SIZE			SAMPLE SIZE	648.32		
SIEVE SIZE	PAN #	PAN OR BAG TARE	SIEVE TARE	WET FRACTION	DRY FRACTION	RETAINED SOIL WEIGHT
			IF APPLICABLE	+ CONTAINER	+ CONTAINER	
2 INCH						
1 INCH						
0.5 INCH			542.63	653.43		110.80
9.5 mm			463.32	614.68		151.36
2 mm			27.35	400.23		372.88
PASSING 2 mm		244.55		257.60		13.05
					TOTAL SIEVED	648.32
					TOTAL RECOVERED	648.09

300 AREA SW B09762 1"-2mm

SIEVE #2						
DRY SIEVED TO 2 mm SIZE			SAMPLE SIZE	3120.2		
SIEVE SIZE	PAN #	PAN OR BAG TARE	SIEVE TARE	WET FRACTION	DRY FRACTION	RETAINED SOIL WEIGHT
			IF APPLICABLE	+ CONTAINER	+ CONTAINER	
2 INCH						
1 INCH						
0.5 INCH	7	244.56		678.54		433.98
9.5 mm	8	247.89		803.81		555.92
2 mm	7	244.54		2274.50		2029.96
PASSING 2 mm	8	247.84		347.43		99.59
					RECOVERED	3119.45
TOTAL OF SIEVE 1+2						
DRY SIEVED TO 2 mm SIZE						
SIEVE SIZE		TOTAL SAMPLE SIZE	3768.52			
		WEIGHT				
2 INCH						
1 INCH						
0.5 INCH		544.78				
9.5 mm		707.28				
2 mm		2402.84				
PASSING 2 mm		112.64				
RECOVERED		3767.54				
% RECOVERED		99.97%				

300 AREA SWB09762-2

BUCKET #				SOIL IN OVEN			
SIZE				SOIL OUT OF OVEN			
FULL BUCKET							
EMPTY BUCKET							
TOTAL SOIL MATERIAL (g)							
VOL. OF BUCKET							
MOISTURE CONTENT							
PAN #	PAN TARE	PAN+SOIL WET WEIGHT	PAN+SOIL DRY WEIGHT	SOIL WET WEIGHT	SOIL DRY WEIGHT	MOISTURE PERCENT	
1							
2							
3							
sieved amount	112.55	Wet SIEVEING OF <2MM FINES					
SIEVE SIZE	PAN #	PAN OR BAG TARE	SIEVE TARE IF APPLICABLE	WET FRACTION + CONTAINER	DRY FRACTION + CONTAINER	SOIL WT.	
2 INCH							
1 INCH							
0.5 INCH							
9.5 mm							
2 mm							
1 mm	7	244.51	460.66	837.48	815.12	109.95	
0.425 mm	8	247.87	328.52	586.72	577.11	0.72	
0.212 mm	9	249.68	387.93	643.64	637.90	0.29	
0.150mm	10	248.15	287.15	593.16	535.38	0.08	
0.075 mm	25	377.6	299.36	682.84	677.56	0.60	
< 0.075	Large 5	604.25			604.57	0.32	
					TOTAL SIEVED	112.55	
					TOTAL RECOVERED	111.96	
					% RECOVERED	99.48	

Sample: B09762

Mass Balance

	Wet Weight (g)	Air Dry Weight (g)	Dry Oven Weight (g)	Moisture Content (%)
Start	4045	--	--	--
Used For				
Moisture Contents	203.91	--	198.68	2.64
Coarse Sieved	--	--	3654.90	--
Fines Sieved	--	112.55	111.96	--
Totals	4045	--	3965.54	

Start 4045 g wet   Accounted for 4070* g wet   % Accounted for = 100.6

*Assume initial moisture of 2.64% for oven dried material collected at end.

Sample: B09763

Description: 0.425 to 2 mm pile
Bucket Size: 1 gallon
Full Bucket Weight (wet g): 3083
Empty Bucket Weight (dry g): 381
Soil (wet g): 2702

Volume of Sample: not recorded

Moisture Content Data (see attached spreadsheet)

Average Moisture Content (%) = 10.69 ± 0.59 * ignore 1 sample error

Procedure:

Moisture content samples (3) were taken immediately (104.25 g wet)
Entire sample was air dried.
Two weighed aliquots of air dried material were sieved (317.94 and 395.08 g).
Moisture content samples (3) were taken at same time to measure air dry moisture (128.10 g air dry).
Amount of material not used was weighed (1562.13 g air).
Total amount of air dry soil sieved was compared to oven dry weights measured to get a correction factor to convert oven dry to air dry (1.0079).
Fraction of air dried material sieved was corrected to total available to estimate total air dry size fractions.
See spread sheet for details.

Final Particle Size

Sieve	Total Oven Dry (g)	Calc. Air Dry (g)	Fraction Sieved	Total Air Dry (g)	% Size
>2 mm	8.58	8.65	.2967	29.15	1.21
>1 mm	193.26	194.78	.2967	656.49	27.32
>0.425 mm	444.68	448.18	.2967	1510.55	62.86
>0.212 mm	41.44	41.77	.2967	140.77	5.86
>0.150 mm	0.55	0.55	.2967	1.87	0.08
>0.075 mm	0.66	0.66	.2967	2.24	0.09
<0.075 mm	18.28	18.42	.2967	62.10	2.58
			Total	2403.17	100.00

300 AREA SW B09763 2mm-0.425mm

BUCKET #	B09763					DATE	
SIZE	2mm-0.425mm			WET SOIL	73.42		
				OVEN DRY SOIL	66.36		
FULL BUCKET	KG	3.083		MOISTURE	10.64%		
EMPTY BUCKET	KG	0.381					
TOTAL SOIL MATERIAL (g)		2702					
VOL. OF BUCKET		1 GAL					
MOISTURE CONTENT							
PAN #	PAN TARE	PAN+SOIL WET WEIGHT	PAN+SOIL DRY WEIGHT	SOIL WET WEIGHT	SOIL DRY WEIGHT	MOISTURE PERCENT	
1	31.19	62.02	62.56	30.83	31.37	-1.72%	ERROR
2	31.2	63.93	60.66	32.73	29.46	11.10%	
3	31.23	71.92	68.13	40.69	36.9	10.27%	
1st wet sieve							
SIEVE SIZE	PAN #	PAN OR BAG TARE	SIEVE TARE IF APPLICABLE	WET FRACTION + CONTAINER	DRY FRACTION + CONTAINER	SOIL WT.	
317.94	gms sieved	air dried					
2 INCH							
1 INCH							
0.5 INCH							
9.5 mm							
2 mm	10-1/1	250.51	433.76	692.98	688.37	4.10	
1 mm	18-1/2	250.23	460.66	823.32	801.76	90.87	
0.425 mm	40-1/3	248.82	325.61	820.27	763.89	189.46	
0.212 mm	70-1/4	248.02	389.96	669.37	656.56	18.58	
0.150 mm	100-1/5	247.96	379.59	634.89	627.72	0.17	
0.075 mm	200-1/6	249.27	371.28	627.00	620.75	0.20	
< 0.075 mm	11	618.09			604.07	14.02	
					TOTAL SIEVED	317.94	
					RECOVERED	317.40	
					% recovered	99.83%	
2nd wet sieve	395.08	grams sieved					
SIEVE SIZE	PAN #	TARE	APPLICABLE	CONTAINER	+ CONTAINER	SOIL WT.	
395.08	gms sieved air dried						
2 mm	10-1/1	250.51	433.76	695.62	688.75	4.48	
1 mm	18-1/2	250.23	460.66	835.86	813.28	102.39	
0.425 mm	40-1/3	248.82	325.61	905.08	829.65	255.22	
0.212 mm	70-1/4	248.02	389.96	675.03	660.84	22.86	
0.150 mm	100-1/5	247.96	379.59	633.24	627.93	0.38	
0.075 mm	200-1/6	249.27	371.28	627.35	621.01	0.46	
< 0.075 mm	2	609.35			613.61	4.26	
					TOTAL SIEVED	395.08	
					RECOVERED	390.05	
					% recovered	98.73%	

Sample: B09763

Mass Balance

	Wet Weight (g)	Air Dry Weight (g)	Oven Dry Weight (g)	Moisture Content (%)
Start	2702	--	--	--
Used For				
Moisture Contents	104.25	~99*	97.73	10.69
Sieve #1	--	317.94	317.40	--
Sieve #2	--	395.08	390.05	--
Moisture Contents	--	128.10	Sample lost	--
Unused Material	--	1562.13	--	--
Totals	2702	2502.25*	--	

% Accounted for: ≥ 92.61
Moisture loss to air drying likely >6%. but less than 10.7%. thus balance probably 98 - 100%

Sample: B09759

Description:	<0.425 mm Slurry		
Bucket Size:	2 carbuoys (one small and one large)		
Full Bucket #1 (wet g):	12873	Full Bucket #2 (wet g):	17300
Empty Bucket (dry g):	1467	Empty Bucket (dry g):	2128
Water Decanted (wet g):	10639	Water Decanted (wet g):	13780
Soil (wet g):	767	Soil (wet g):	1392

Moisture Content Data (see attached spreadsheet)

Average Moisture Content (%) = 35.45 ± 20.95

Procedure:

Excess water was decanted off both carbuoys.
Remaining wet solids placed in large pan.
Moisture content solids taken immediately--3 samples--total 70.07 g wet.
Sample air dried and well mixed. Air dry weight recorded--1630.85 g.
Moisture content samples taken--2 samples--65.24 g air dry.
Two aliquots taken for wet sieving--total 827.35 g air dry.
Oven dry weights from 2 sievings combined.
% size fractions determined from oven dry weights.
Mass balance calculations performed to get slurry content.
See spreadsheet for wet sieving data.

Combined Wet Sievings

Size	Oven-Dry Weight (g)	%
2 mm	0.24	0.03
1 mm	10.50	1.29
0.425 mm	21.81	2.68
0.212 mm	426.01	52.35
0.150 mm	78.84	9.69
0.075 mm	91.11	11.20
<0.075 mm	185.31	22.77
Total	813.82	100.01

300 AREA SW B09759 SLURRY SOIL

BUCKET #	B09759	fines from slurry sample 2nd set 300 area				WET SOIL	70.07
SIZE	CARBOYS					OVEN-DRY SOI	53.15
FULL BUCKET 1	KG	2.234	FULL BUCKET 2	KG	3.52	MOISTURE	31.83%
EMPTY BUCKET	KG	1.467	EMPTY BUCKET	KG	2.128		
TOTAL SOIL MATERIAL (g)		767	TOTAL SOIL MATERIAL (g)		1392		
VOL. OF BUCKET		SML CARBOY	VOL. OF BUCKET		LRG CARBOY	TOTAL WT	2159
						oven dry tot ca	1471.69
MOISTURE CONTENT		WEIGHTS IN GRAMS		wet to oven			
PAN #	PAN TARE	PAN+SOIL WET WEIGHT	PAN+SOIL DRY WEIGHT	SOIL WET WEIGHT	SOIL DRY WEIGHT	MOISTURE PERCENT	
1	31.07	51.99	49.23	20.92	18.16	15.20%	
2	31.07	55.49	46.62	24.42	15.55	57.04%	
3	30.71	55.44	49.15	24.73	18.44	34.11%	
				air to oven			
1	31.37	68.39	67.89	37.02	36.52	1.37%	
2	31.08	59.3	58.88	28.22	27.8	1.51%	
		oven dry calc	285.03				
1ST WET SIEVE		Air dried	418.14	grams			
SIEVE SIZE	PAN #	PAN OR BAG TARE	SIEVE TARE IF APPLICABLE	WET FRACTION + CONTAINER	DRY FRACTION + CONTAINER	SOIL WT. GM	
2 mm	/ 1	250.51	433.76	690.36	684.63	0.36	
1 mm	/ 2	250.23	460.66	723.4	716.59	5.70	
0.425 mm	/ 3	248.82	325.61	595.08	585.79	11.36	
0.212 mm	/ 4	248.02	389.96	932.71	850.78	212.80	
0.150 mm	/ 5	247.96	379.59	689.13	667.73	40.18	
0.075 mm	/ 6	249.27	371.28	694.14	667.30	46.75	
< 0.075 mm	Large 5	604.15	4722.44		690.48	86.33	total x<0.075
	Large 6	611.25	1050.19		622.17	10.92	97.25
Volume of Rinse	mls	4557.23			tot recovered	414.40	
	2ND WET SIEVE		Air dried	409.21	grams		
SIEVE SIZE	PAN #	PAN OR BAG TARE	SIEVE TARE IF APPLICABLE	WET FRACTION + CONTAINER	DRY FRACTION + CONTAINER	SOIL WT.	
2 mm	/ 1	250.51	433.76	690.28	684.15	-0.12	
1 mm	/ 2	250.23	460.66	723.83	715.69	4.80	
0.425 mm	/ 3	248.82	325.61	594.68	584.88	10.45	
0.212 mm	/ 4	248.02	389.96	929.06	851.19	213.21	
0.150 mm	/ 5	247.96	379.59	689.11	666.21	38.66	
0.075 mm	/ 6	249.27	371.28	699.28	664.91	44.36	
< 0.075 mm	Large 6	611.25	5348.47		696.44	85.19	total x<0.075
	Large 2	609.34	912.86		612.21	2.87	88.06
Volume of Rinse	mls	5040.74			tot recovered	399.42	

Sample: B09759

Mass Balance

	Wet Weight (g)	Water Removed (g)	Air Dry Weight (g)	Oven Dry Weight (g)	Moisture Content (%)
Start					
Carbuoy 1	12873	10639	--	--	--
Carbuoy 2	17300	13780	--	--	--
Empty Carbuoys	3595	--	--	--	--
Total	26578				
Solids					
Carbuoy 1	767	--	--	--	--
Carbuoy 2	1392	--	--	--	--
Total	2159				
Removed					
Moisture Content	70.07	16.92	--	53.15	35.45
Remaining	2088.93	458.08	1630.85	1607.70 (calc)	1.44 (calc)
Second Moisture	--	0.92	65.24	64.32	1.44
2 Wet Sievings	--	13.53	827.35	813.82	≤1.66
Remaining Sample	--	(10.48)	738.26	727.78 (calc)	1.44 (calc)
Start	26578	--	--	--	--
Accounted for	--	24894	--	1659.07	

% Accounted for = 99.91

Slurry Calculation

Total Dry Weight of Solids (oven dry) = 1659.07 g
Total Water Present at Start (g) = 24894

Ratio: 66.6 g/ℓ

APPENDIX B

XRF DATA FOR VARIOUS PARTICLE-SIZED MATERIAL AFTER LABORATORY WET SIEVING

APPENDIX B

XRF DATA FOR VARIOUS PARTICLE-SIZED MATERIAL AFTER LABORATORY WET SIEVING

The following data includes the chain of custody forms for samples of campaign 1 and 2 and campaign 4 size separates that were submitted for XRF measurement. Raw data are provided because some information on minor elements is never mentioned in the text but data are available herein, should readers have interest.

All size separates that were submitted were run in duplicate and designated as X-X-A or X-X-B. Sample designations are shown below.

XRF Samples	Text Designation	
1-7-A, B	Campaign 1	<0.075 mm
1-6-A, B	Campaign 1	0.075 to 0.150 mm
1-5-A, B	Campaign 1	0.150 to 0.212 mm
1-4-A, B	Campaign 1	0.212 to 0.425 mm
1-3-A, B	Campaign 1	0.425 to 1.0 mm
1-2-A, B	Campaign 1	1.0 to 2.0 mm
1-1-A, B	Campaign 1	2.0 to 9.5 mm
2-7-A, B	Campaign 2	<0.075 mm
2-6-A, B	Campaign 2	0.075 to 0.150 mm
2-5-A, B	Campaign 2	0.150 to 0.212 mm
2-4-A, B	Campaign 2	0.212 to 0.425 mm
2-3-A, B	Campaign 2	0.425 to 1.0 mm
2-2-A, B	Campaign 2	1.0 to 2.0 mm
2-1-A, B	Campaign 2	2.0 to 9.5 mm
300-2-1 A, B	Campaign 4	2 to 9.5 mm
300-2-3 A, B	Campaign 4	1.0 to 2.0 mm
300-2-5 A, B	Campaign 4	0.425 to 1.0 mm

XRF Samples	Text Designation	
300-2-7 A, B	Campaign 4	0.212 to 0.425 mm
300-2-9 A, B	Campaign 4	0.150 to 0.212 mm
300-2-11 A, B	Campaign 4	0.075 to 0.150 mm
300-2-13 A, B	Campaign 4	<0.075 mm
300-2-18 A, B	Campaign 4	Composite <2 mm (not discussed in text)

A/O 93.010093 to 93.010106

Chain of Custody /Analytical Request Form — No. 300-1 XRF

To: Ron Sanders & Eric Wyse Date: 8-5-93 WP#: K16851 Org: D7D35
Requested by: Ginny LeGore (name) [signature] (signature) 6-5019 (tel) P8-37 (mail stop)

Relinquished by: Received by: Date/Time:
Relinquished by: Received by: Date/Time:
Relinquished by: Received by: Date/Time:
Relinquished by: Received by: Date/Time:

Analysis Requested: Please provide XRF analysis for the __ samples described below. Jeff said to run samples in duplicate (2 runs each sample)

Identification #

1-1 to 1-7	Soil size fractions XRF	metals & U		
2-1 to 2-7				
807 MN 7	Liquid samples	ICP-MS - U Cu, Zr and trace metals		
808 NM 3	* need to be acidified			

Material Description:

Special Storage or Handling Requirements: ☑ None ☐ Other:

Disposal of Samples: ☐ Discard ☑ Return ☐ Other:

Requested Reports/Additional Instructions:

QA Requirements: Impact Level I II III (indicate level) SOW#________

________ QA Representative approval required for first COC/ARF

QA Rep. sign /date in series for internal work. Not required external work.

Results must be signed and dated by the analyst and reviewer, identifying the measuring and test equipment and the procedure used (including revision).

To the best of my knowledge, this work was accomplished in accordance with the requirements of this Analytical Request Form.

By: [signature] 8-23-93 Date: ________

Responsible Analyst or Group Manager

RETURN THIS FORM OR A COPY TO THE REQUESTOR

The report/data furnished has been reviewed and to the best of my knowledge complies with the above request.

By: R Jeff Serne for Ginny LeGore Date: 8/26/93

Requestor

X-RAY FLUORESCENCE ANALYSIS

Final Report
pg 239-257
NJA
8-23-93

..ISOR:	V.G. LEGORE
..E OF WORK:	08-23-93
..N ORDER NUMBER:	KI6815
..E OF MATERIAL:	SOIL SIZE FRACTIONS

S..RIES NAMES ASSOCIATED WITH THIS SAMPLE SET:

F2GL81
.GL801
..L601
..GL801
..GL82
...902
...GL81
...802

... ..PTION OF XRFA TECHNIQUES USED

..RMAL PROCEDURE FOR SEDIMENT SAMPLES. SAMPLES WERE ..ROUND TO LESS THAN 300 MESH AND MOUNTED ON 35MM SLIDES WITH THE SAMPLES BEING SUPPORTED BY STRETCHED PARA-FILM. ..ECAUSE THE SAMPLES WERE SLIGHITLY RADIOACTIVE, A SECOND CONTAINMENT OF A POLYPROPYLENE ENVELOPE WAS ALSO USED. SAMPLES WERE THEN PROCESSED IN COMPLIANCE WITH PNL TEST ..ROCEDURE 7-40.48 REV-1.

..ST:	RON SANDERS [signature] 8-23-93	REVIEW:	[signature] 8-23-93
..E:	376-3877		

EL	USGS BCR-1	+/-	2-1-A	+/-	2-1-B	+/-	2-2-A	+/-
AL	6.96	0.40	7.96	0.45	7.90	0.45	8.57	0.47
SI	26.0	1.3	20.4	1.0	20.7	1.0	17.99	0.91
P	0.176	0.030	0.332	0.035	0.380	0.037	0.425	0.037
S	0.079	0.012	< 0.022		0.036	0.012	0.100	0.013
CL	< 0.009		< 0.010		< 0.010		0.020	0.005
K	1.396	0.070	0.890	0.045	0.902	0.046	0.866	0.044
CA	4.95	0.25	5.04	0.25	5.14	0.26	4.57	0.23
TI	1.325	0.066	1.141	0.057	1.136	0.057	0.672	0.034
V	416.	24.	322.	19.	335.	20.	177.	12.
CR	< 5.6		194.	10.	214.	11.	384.	20.
		+/-		+/-		+/-		+/-
AL	6.0	1.1	8.0	1.1	7.1	1.1	7.7	1.1
SI	25.4	1.5	20.5	1.3	20.5	1.3	18.1	1.2
MN	1415.	77.	1154.	63.	1131.	63.	827.	47.
FE	9.40	0.47	7.24	0.36	7.14	0.36	4.91	0.25
CO	< 94.		< 77.		< 79.		< 61.	
NI	23.5	3.9	444.	24.	505.	27.	723.	38.
CU	19.4	2.9	5570.	280.	6190.	310.	9370.	470.
ZN	121.2	7.2	157.6	9.5	153.6	9.5	159.7	9.9
GA	20.9	2.2	54.6	3.7	59.0	4.0	74.7	4.7
HG	< 6.3		8.0	3.0	7.4	3.0	9.6	2.7
SE	< 1.9		< 1.9		< 1.8		< 1.7	
PB	14.3	2.7	44.4	3.5	42.6	3.6	103.0	6.1
AS	< 3.3		3.6	1.9	7.8	2.0	< 4.1	
BR	< 1.7		< 1.7		< 1.7		< 1.7	
		+/-		+/-		+/-		+/-
RB	47.2	3.5	52.6	5.2	53.6	5.4	105.8	8.9
U	< ~~4.5~~		1590.	110.	1780.	120.	3290.	230.
SR	342.	24.	401.	20.	393.	20.	328.	23.
Y	35.3	2.6	35.8	2.9	36.1	2.9	27.5	2.6
ZR	189.	13.	2120.	150.	2330.	160.	3260.	230.
NB	12.0	1.1	4.2	1.5	< 2.9		< 3.9	
MO	1.79	0.90	12.2	2.9	14.0	2.9	13.5	3.7
		+/-		+/-		+/-		+/-
RU	< 6.9		< 7.4		< 7.0		< 8.9	
RH	< 7.4		< 7.4		< 6.7		< 8.7	
PD	< 8.3		< 7.9		< 7.1		< 8.6	
AG	< 8.9		33.4	4.5	36.6	4.6	50.7	5.3
CD	< 9.9		< 9.7		< 7.5		< 8.5	
IN	< 11.		< 9.5		< 8.6		< 9.7	
SN	< 12.		52.6	6.3	51.9	5.9	91.6	8.3
SB	< 14.		< 12.		< 11.		< 12.	
TE	< 15.		< 13.		< 11.		< 13.	
I	< 19.		< 17.		< 15.		< 17.	
CS	< 21.		< 19.		< 16.		< 19.	
BA	642.	47.	562.	41.	552.	40.	836.	60.
LA	38.	14.	40.	13.	< 24.		40.	14.
CE	50.	18.	50.	16.	52.	16.	57.	16.

9413273.0120

	EL	2-2-B	+/-	EL	2-3-A	+/-	EL	2-3-B	+/-	EL	2-4-A	+/-
TI												
%	AL	0.75	0.40	AL	7.50	0.43	AL	7.45	0.42	AL	7.19	0.41
%	SI	10.71	0.95	SI	27.5	1.4	SI	27.0	1.4	SI	25.3	1.3
%	P	0.466	0.039	P	0.195	0.031	P	0.231	0.031	P	0.209	0.028
%	S	0.076	0.013	S	0.053	0.012	S	0.058	0.012	S	0.041	0.010
%	CL	0.015	0.005	CL	< 0.009		CL	< 0.009		CL	< 0.009	
%	K	0.926	0.047	K	1.459	0.073	K	1.377	0.069	K	1.313	0.066
%	CA	4.87	0.24	CA	3.86	0.19	CA	3.73	0.19	CA	3.15	0.16
%	TI	0.737	0.037	TI	0.754	0.038	TI	0.726	0.036	TI	0.564	0.028
PPM	V	172.	12.	V	149.	12.	V	159.	12.	V	109.4	9.3
PPM	CR	393.	20.	CR	156.3	8.4	CR	150.0	8.1	CR	237.	12.
CR			+/-			+/-			+/-			+/-
%	AL	7.8	1.2	AL	7.0	1.0	AL	7.5	1.0	AL	6.39	0.99
%	SI	17.3	1.1	SI	26.6	1.5	SI	25.1	1.5	SI	24.3	1.4
PPM	MN	805.	46.	MN	762.	43.	MN	742.	43.	MN	660.	38.
%	FE	4.81	0.24	FE	4.33	0.22	FE	4.34	0.22	FE	3.77	0.19
PPM	CO	< 61.		CO	< 58.		CO	< 58.		CO	< 53.	
PPM	NI	700.	37.	NI	235.	13.	NI	241.	14.	NI	342.	19.
PPM	CU	9080.	460.	CU	2700.	140.	CU	2870.	140.	CU	3540.	180.
PPM	ZN	150.6	9.5	ZN	95.4	6.1	ZN	97.5	6.2	ZN	102.0	6.4
PPM	GA	71.9	4.5	GA	34.4	2.5	GA	34.0	2.5	GA	35.7	2.6
PPM	HG	6.4	2.7	HG	< 4.6		HG	< 4.5		HG	4.8	2.2
PPM	SE	< 1.5		SE	< 1.5		SE	< 1.5		SE	< 1.4	
PPM	PB	79.5	5.0	PB	47.7	3.4	PB	41.2	3.2	PB	63.4	4.1
PPM	AS	5.4	2.1	AS	< 3.1		AS	4.9	1.5	AS	5.7	1.7
PPM	BR	< 1.7		BR	< 1.4		BR	< 1.4		BR	< 1.5	
AG			+/-			+/-			+/-			+/-
PPM	RB	86.6	7.8	RB	60.4	5.2	RB	62.3	5.2	RB	70.1	5.8
PPM	U	3250.	230.	U	1300.	92.	U	1294.	91.	U	1410.	99.
PPM	SR	324.	23.	SR	373.	26.	SR	361.	25.	SR	386.	27.
PPM	Y	26.7	2.6	Y	25.6	2.1	Y	25.6	2.1	Y	26.4	2.2
PPM	ZR	3250.	230.	ZR	1065.	75.	ZR	1050.	74.	ZR	1367.	96.
PPM	NB	< 3.8		NB	3.8	1.2	NB	3.5	1.2	NB	5.1	1.4
PPM	MO	9.1	3.6	MO	< 3.9		MO	< 3.7		MO	< 4.4	
AM			+/-			+/-			+/-			+/-
PPM	RU	< 8.9		RU	< 6.5		RU	< 6.0		RU	< 8.2	
PPM	RH	< 8.7		RH	< 6.8		RH	< 6.2		RH	< 8.2	
PPM	PD	< 8.3		PD	< 7.0		PD	< 6.7		PD	< 8.6	
PPM	AG	53.1	5.6	AG	16.4	3.7	AG	17.6	3.6	AG	34.9	5.3
PPM	CD	< 8.5		CD	< 7.7		CD	< 7.2		CD	< 9.3	
PPM	IN	< 9.8		IN	< 8.8		IN	< 8.2		IN	< 10.	
PPM	SN	85.0	8.0	SN	38.8	5.4	SN	34.7	5.0	SN	46.5	6.5
PPM	SB	< 12.		SB	< 11.		SB	< 10.		SB	< 13.	
PPM	TE	< 13.		TE	< 12.		TE	< 12.		TE	< 14.	
PPM	I	< 17.		I	< 16.		I	< 15.		I	< 18.	
PPM	CS	< 18.		CS	< 17.		CS	< 16.		CS	< 19.	
PPM	BA	934.	60.	BA	982.	70.	BA	995.	71.	BA	1009.	72.
PPM	LA	46.	13.	LA	< 24.		LA	34.	11.	LA	< 28.	
PPM	CE	56.	16.	CE	35.	16.	CE	42.	14.	CE	< 36.	

UNITS	EL	2-4-B	+/-	EL	2-5-A	+/-	EL	2-5-B	+/-	EL	2-6-A	+/-
TI												
%	AL	7.61	0.43	AL	6.94	0.40	AL	8.26	0.46	AL	8.52	0.47
%	SI	25.8	1.3	SI	22.6	1.1	SI	23.1	1.2	SI	18.31	0.93
%	P	0.242	0.031	P	0.237	0.030	P	0.321	0.032	P	0.368	0.035
%	S	0.046	0.011	S	0.031	0.011	S	0.040	0.011	S	0.048	0.012
%	CL	< 0.009		CL	< 0.009		CL	< 0.009		CL	< 0.009	
%	K	1.350	0.068	K	1.212	0.061	K	1.191	0.060	K	0.999	0.050
%	CA	3.30	0.17	CA	3.84	0.19	CA	3.96	0.20	CA	4.82	0.24
%	TI	0.577	0.029	TI	0.796	0.040	TI	0.781	0.039	TI	0.658	0.033
PPM	V	110.0	9.8	V	178.	13.	V	174.	13.	V	115.	10.
PPM	CR	238.	12.	CR	272.	14.	CR	342.	17.	CR	445.	23.
ZR			+/-			+/-			+/-			+/-
%	AL	6.9	1.0	AL	5.5	1.1	AL	7.68	0.97	AL	7.7	1.1
%	SI	25.4	1.5	SI	21.8	1.3	SI	23.6	1.4	SI	18.2	1.2
PPM	MN	650.	38.	MN	893.	50.	MN	907.	51.	MN	871.	49.
%	FE	3.85	0.19	FE	5.59	0.28	FE	5.49	0.27	FE	4.82	0.24
PPM	CO	< 54.		CO	< 66.		CO	< 66.		CO	< 61.	
PPM	NI	355.	19.	NI	377.	21.	NI	506.	27.	NI	689.	36.
PPM	CU	3720.	190.	CU	3670.	180.	CU	4820.	240.	CU	6890.	350.
PPM	ZN	99.6	6.4	ZN	119.9	7.4	ZN	135.3	8.2	ZN	154.0	9.4
PPM	GA	38.5	2.7	GA	39.8	2.9	GA	46.1	3.2	GA	55.3	3.7
PPM	HG	< 4.4		HG	< 4.9		HG	5.9	2.5	HG	8.6	2.7
PPM	SE	< 1.4		SE	< 1.6		SE	< 1.6		SE	< 1.6	
PPM	PB	59.7	3.9	PB	69.2	4.5	PB	80.8	5.0	PB	114.7	6.6
PPM	AS	4.5	1.7	AS	6.5	1.9	AS	4.7	2.0	AS	6.9	2.3
PPM	BR	< 1.4		BR	< 1.5		BR	< 1.6		BR	< 1.7	
AG			+/-			+/-			+/-			+/-
PPM	RB	70.8	5.7	RB	65.9	5.7	RB	68.4	6.2	RB	93.7	8.0
PPM	U	1356.	95.	U	1510.	110.	U	1880.	130.	U	2860.	200.
PPM	SR	359.	25.	SR	368.	26.	SR	376.	26.	SR	373.	26.
PPM	Y	23.6	2.0	Y	32.5	2.6	Y	30.6	2.6	Y	31.8	2.8
PPM	ZR	1343.	94.	ZR	1500.	100.	ZR	1850.	130.	ZR	2640.	180.
PPM	NB	3.7	1.2	NB	10.7	1.5	NB	7.0	1.6	NB	< 3.5	
PPM	MO	< 3.9		MO	< 4.5		MO	< 5.3		MO	10.7	3.2
SM			+/-			+/-			+/-			+/-
PPM	RU	< 6.2		RU	< 6.9		RU	< 8.5		RU	< 8.5	
PPM	RH	< 6.4		RH	< 7.1		RH	< 8.8		RH	< 8.1	
PPM	PD	< 6.8		PD	< 6.9		PD	< 9.0		PD	< 8.2	
PPM	AG	33.5	4.2	AG	43.1	4.7	AG	44.5	5.6	AG	72.0	6.5
PPM	CD	< 7.2		CD	< 7.7		CD	< 9.4		CD	< 8.1	
PPM	IN	< 7.7		IN	< 8.4		IN	< 10.		IN	< 9.3	
PPM	SN	50.8	5.7	SN	55.0	6.2	SN	86.9	8.4	SN	110.6	9.3
PPM	SB	< 10.		SB	< 11.		SB	< 13.		SB	< 12.	
PPM	TE	< 11.		TE	< 12.		TE	< 15.		TE	< 12.	
PPM	I	< 15.		I	< 16.		I	< 19.		I	17.0	8.5
PPM	CS	< 17.		CS	< 19.		CS	< 22.		CS	< 19.	
PPM	BA	1020.	73.	BA	1136.	81.	BA	1090.	78.	BA	1480.	100.
PPM	LA	< 23.		LA	57.	13.	LA	56.	15.	LA	31.	13.
PPM	CE	47.	14.	CE	62.	17.	CE	90.	18.	CE	71.	16.

UNITS	EL	2-6-B	+/-	EL	2-7-A	+/-	EL	2-7-B	+/-	EL	USGS BCR-1+200 U	+/-
TI												
%	AL	8.60	0.48	AL	9.14	0.50	AL	8.69	0.49	AL	6.99	0.43
%	SI	19.00	0.97	SI	11.56	0.59	SI	11.99	0.61	SI	25.5	1.3
%	P	0.357	0.036	P	0.434	0.036	P	0.474	0.038	P	0.151	0.035
%	S	0.051	0.012	S	0.080	0.012	S	0.070	0.012	S	0.086	0.015
%	CL	< 0.009		CL	< 0.009		CL	< 0.009		CL	< 0.012	
%	K	0.997	0.050	K	0.751	0.038	K	0.757	0.038	K	1.414	0.071
%	CA	4.83	0.24	CA	4.54	0.23	CA	4.53	0.23	CA	4.90	0.25
%	TI	0.674	0.034	TI	0.416	0.021	TI	0.404	0.020	TI	1.280	0.065
PPM	V	90.2	9.9	V	< 16.		V	< 16.		V	385.	24.
PPM	CR	454.	23.	CR	787.	40.	CR	699.	35.	CR	< 6.5	
ZR												
%	AL	6.4	1.1	AL	8.9	1.2	AL	8.9	1.2	AL	6.7	1.2
%	SI	18.1	1.2	SI	12.06	0.90	SI	12.51	0.95	SI	25.2	1.5
PPM	MN	884.	50.	MN	818.	46.	MN	792.	45.	MN	1391.	76.
%	FE	4.79	0.24	FE	2.85	0.14	FE	2.96	0.14	FE	9.41	0.47
PPM	CO	< 61.		CO	< 43.		CO	< 45.		CO	< 97.	
PPM	NI	667.	35.	NI	1019.	52.	NI	933.	48.	NI	26.7	4.6
PPM	CU	6800.	340.	CU	10000.	500.	CU	9100.	460.	CU	20.5	3.1
PPM	ZN	149.3	9.2	ZN	261.	14.	ZN	246.	14.	ZN	124.9	7.4
PPM	GA	60.9	3.9	GA	72.4	4.5	GA	68.6	4.3	GA	21.7	2.2
PPM	HG	10.5	2.7	HG	13.1	2.6	HG	11.6	2.7	HG	< 6.3	
PPM	SE	< 1.6		SE	< 1.6		SE	< 1.6		SE	< 1.8	
PPM	PB	110.4	6.4	PB	183.5	9.8	PB	175.2	9.5	PB	12.0	2.5
PPM	AS	6.5	2.3	AS	5.0	2.5	AS	7.7	2.5	AS	< 3.3	
PPM	BR	< 1.7		BR	< 1.9		BR	< 2.0		BR	< 1.7	
			+/-			+/-			+/-			+/-
PPM	RB	95.3	8.1	RB	250.	19.	RB	231.	18.	RB	43.3	3.5
PPM	U	2850.	200.	U	8930.	620.	U	8300.	580.	U	190.	14.
PPM	SR	364.	26.	SR	454.	32.	SR	430.	31.	SR	316.	22.
PPM	Y	29.4	2.6	Y	17.5	2.9	Y	16.9	3.0	Y	38.5	2.8
PPM	ZR	2580.	180.	ZR	3960.	280.	ZR	3720.	260.	ZR	192.	14.
PPM	NB	< 3.4		NB	< 5.9		NB	< 6.2		NB	9.7	1.0
PPM	MO	< 5.9		MO	15.7	5.2	MO	< 10.		MO	4.5	1.0
			+/-			+/-			+/-			+/-
PPM	RU	< 8.0		RU	< 11.		RU	< 12.		RU	< 4.7	
PPM	RH	< 7.1		RH	< 11.		RH	< 11.		RH	< 4.8	
PPM	PD	< 7.8		PD	< 10.		PD	< 11.		PD	< 5.5	
PPM	AG	70.1	6.4	AG	108.6	8.7	AG	109.1	9.1	AG	< 6.2	
PPM	CD	9.8	3.9	CD	< 8.1		CD	< 8.9		CD	12.2	3.5
PPM	IN	< 8.7		IN	11.2	4.3	IN	< 10.		IN	< 7.5	
PPM	SN	97.2	8.3	SN	251.	18.	SN	216.	16.	SN	< 7.9	
PPM	SB	< 11.		SB	< 11.		SB	< 12.		SB	< 9.6	
PPM	TE	< 12.		TE	< 13.		TE	< 14.		TE	< 11.	
PPM	I	< 16.		I	21.3	9.1	I	< 20.		I	< 13.	
PPM	CS	< 17.		CS	< 20.		CS	< 22.		CS	< 15.	
PPM	BA	1500.	110.	BA	4800.	340.	BA	4450.	310.	BA	684.	44.
PPM	LA	37.	13.	LA	< 27.		LA	< 30.		LA	29.	11.
PPM	CE	51.	15.	CE	53.	16.	CE	61.	18.	CE	46.	13.

		EL	USGS BCR-1	+/-	EL	USGS BCR-1	+/-	EL	1-1-A	+/-	EL	1-1-B	+/-
TI													
	%	AL	6.82	0.39	AL	6.98	0.47	AL	13.60	0.76	AL	12.18	0.70
	%	SI	25.4	1.3	SI	25.7	1.3	SI	17.23	0.89	SI	15.79	0.82
	%	P	0.169	0.030	P	0.168	0.043	P	0.151	0.039	P	0.082	0.038
	%	S	0.070	0.012	S	0.119	0.017	S	0.042	0.014	S	< 0.029	
	%	CL	< 0.009		CL	< 0.013		CL	< 0.012		CL	< 0.012	
	%	K	1.402	0.071	K	1.350	0.069	K	0.673	0.035	K	0.671	0.035
	%	CA	4.94	0.25	CA	4.81	0.24	CA	4.86	0.24	CA	4.83	0.24
	%	TI	1.320	0.066	TI	1.277	0.064	TI	1.017	0.051	TI	1.015	0.051
	PPM	V	406.	23.	V	443.	20.	V	320.	22.	V	317.	22.
	PPM	CR	< 5.6		CR	< 8.4		CR	97.4	6.3	CR	103.4	6.5
ZR													
	%	AL	7.3	1.0	AL	6.9	1.7	AL	13.1	1.9	AL	12.0	1.9
	%	SI	26.5	1.5	SI	25.5	1.7	SI	16.0	1.3	SI	14.9	1.3
	PPM	~~MN~~	~~1410.~~	~~77.~~	~~MN~~	~~1423.~~	~~84.~~	~~MN~~	~~1282.~~	~~75.~~	~~MN~~	1301.	76.
		FE	9.43	0.47	FE	9.25	0.46	FE	7.13	0.36	FE	7.13	0.36
	PPM	CO	< 92.		CO	< 130.		CO	< 110.		CO	< 110.	
	PPM	NI	17.9	3.9	NI	15.5	5.5	NI	129.	10.	NI	127.	10.
	PPM	CU	15.6	2.8	CU	16.4	3.7	CU	885.	47.	CU	872.	46.
	PPM	ZN	124.8	7.3	ZN	113.3	7.8	ZN	107.8	7.6	ZN	110.1	7.7
	PPM	GA	22.2	2.2	GA	19.7	2.9	GA	26.0	2.9	GA	24.4	2.9
	PPM	HG	< 6.1		HG	< 8.3		HG	< 7.4		HG	7.5	3.7
	PPM	SE	< 1.8		SE	< 2.5		SE	< 2.3		SE	< 2.1	
	PPM	PB	12.8	2.5	PB	13.8	3.6	PB	35.5	4.1	PB	30.1	3.9
	PPM	AS	< 3.1		AS	< 4.5		AS	< 4.4		AS	< 4.4	
	PPM	BR	< 1.6		BR	< 2.3		BR	< 2.1		BR	< 2.2	
AG													
	PPM	RB	46.8	3.5	RB	45.3	3.5	RB	26.4	3.2	RB	24.8	3.0
	PPM	U	< 4.7		U	< 5.3		U	689.	48.	U	654.	46.
	PPM	SR	346.	24.	SR	330.	23.	SR	263.	18.	SR	251.	18.
	PPM	Y	36.6	2.7	Y	32.1	2.5	Y	29.3	2.4	Y	31.0	2.5
	PPM	ZR	187.	13.	ZR	171.	12.	ZR	433.	30.	ZR	419.	29.
	PPM	NB	11.8	1.1	NB	11.7	1.3	NB	7.5	1.3	NB	8.5	1.2
	PPM	MO	1.97	0.91	MO	2.31	0.99	MO	3.3	1.6	MO	< 2.8	
AM													
	PPM	RU	< 6.8		RU	< 7.4		RU	< 8.4		RU	< 7.1	
	PPM	RH	< 7.5		RH	< 8.1		RH	< 8.7		RH	< 7.5	
	PPM	PD	< 8.1		PD	< 8.6		PD	< 9.3		PD	< 8.3	
	PPM	AG	< 9.3		AG	< 9.7		AG	17.5	5.3	AG	10.6	4.4
	PPM	CD	< 10.		CD	< 11.		CD	< 11.		CD	< 9.3	
	PPM	IN	< 11.		IN	< 12.		IN	< 12.		IN	< 11.	
	PPM	SN	18.5	6.1	SN	< 13.		SN	17.5	6.5	SN	< 11.	
	PPM	SB	< 13.		SB	< 16.		SB	< 15.		SB	< 13.	
	PPM	TE	< 16.		TE	< 16.		TE	< 17.		TE	< 15.	
	PPM	I	< 19.		I	< 20.		I	< 21.		I	< 19.	
	PPM	CS	< 23.		CS	< 21.		CS	< 21.		CS	< 20.	
	PPM	BA	670.	50.	BA	633.	47.	BA	579.	43.	BA	598.	44.
	PPM	LA	30.	15.	LA	< 34.		LA	< 32.		LA	< 29.	
		CE	61.	19.	CE	58.	19.	CE	46.	19.	CE	< 33.	

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TS	EL	1-2-A	+/-	EL	1-2-B	+/-	EL	1-3-A	+/-	EL	1-3-B	+/-
TI												
%	AL	7.91	0.49	AL	7.81	0.49	AL	7.25	0.47	AL	8.12	0.50
%	SI	24.4	1.2	SI	23.8	1.2	SI	27.4	1.4	SI	28.6	1.5
%	P	0.239	0.041	P	0.199	0.040	P	0.163	0.038	P	0.146	0.039
%	S	0.051	0.016	S	0.052	0.015	S	0.047	0.015	S	< 0.029	
%	CL	< 0.013		CL	< 0.012		CL	< 0.012		CL	< 0.012	
%	K	1.146	0.058	K	1.127	0.057	K	1.342	0.068	K	1.343	0.068
%	CA	4.05	0.20	CA	4.03	0.20	CA	3.39	0.17	CA	3.41	0.17
%	TI	0.815	0.041	TI	0.788	0.040	TI	0.704	0.035	TI	0.729	0.037
PPM	V	202.	17.	V	179.	16.	V	157.	15.	V	169.	15.
PPM	CR	159.0	9.0	CR	169.7	9.5	CR	100.7	6.3	CR	108.7	6.7
ZR			+/-			+/-			+/-			+/-
%	AL	6.1	1.7	AL	7.1	1.7	AL	9.0	1.6	AL	9.0	1.7
%	SI	23.0	1.6	SI	22.7	1.6	SI	27.0	1.8	SI	26.3	1.8
PPM	MN	842.	54.	MN	906.	56.	MN	787.	46.	MN	741.	48.
%	FE	5.27	0.26	FE	5.25	0.26	FE	4.35	0.22	FE	4.55	0.23
PPM	CO	< 92.		CO	< 92.		CO	< 81.		CO	< 86.	
PPM	NI	244.	15.	NI	222.	15.	NI	148.	10.	NI	137.	10.
PPM	CU	2650.	130.	CU	2670.	140.	CU	1175.	61.	CU	1215.	63.
PPM	ZN	100.9	7.8	ZN	101.1	7.8	ZN	76.9	6.0	ZN	83.3	6.4
PPM	GA	34.9	3.3	GA	35.3	3.3	GA	23.2	2.6	GA	24.1	2.7
PPM	HG	7.3	3.5	HG	10.9	3.4	HG	< 6.1		HG	< 6.3	
PPM	SE	< 2.1		SE	< 2.2		SE	< 1.9		SE	< 2.1	
PPM	PB	47.1	4.5	PB	39.2	4.2	PB	29.4	3.6	PB	37.3	3.9
PPM	AS	< 4.6		AS	< 4.6		AS	6.8	2.1	AS	< 4.1	
PPM	BR	< 2.2		BR	< 2.2		BR	< 2.0		BR	< 2.1	
[illegible]			+/-			+/-			+/-			+/-
PPM	RB	62.2	5.4	RB	60.1	5.3	RB	59.3	4.7	RB	54.1	4.5
PPM	U	1321.	93.	U	1293.	91.	U	664.	47.	U	665.	47.
PPM	SR	356.	25.	SR	349.	25.	SR	379.	27.	SR	387.	27.
PPM	Y	28.9	2.4	Y	29.4	2.5	Y	27.9	2.2	Y	28.1	2.3
PPM	ZR	950.	67.	ZR	956.	67.	ZR	445.	31.	ZR	454.	32.
PPM	NB	6.9	1.5	NB	9.0	1.5	NB	9.1	1.2	NB	8.1	1.2
PPM	MO	< 3.9		MO	< 4.0		MO	< 2.7		MO	< 2.9	
AM			+/-			+/-			+/-			+/-
PPM	RU	< 8.2		RU	< 7.8		RU	< 5.9		RU	< 7.5	
PPM	RH	< 8.9		RH	< 8.5		RH	< 7.7		RH	< 8.1	
PPM	PD	< 9.3		PD	< 9.0		PD	< 7.9		PD	< 8.9	
PPM	AG	18.3	4.8	AG	29.9	5.0	AG	9.0	4.2	AG	14.2	4.7
PPM	CD	< 10.		CD	< 9.7		CD	< 9.4		CD	< 9.9	
PPM	IN	< 11.		IN	< 11.		IN	< 9.9		IN	< 11.	
PPM	SN	32.2	6.5	SN	45.2	6.7	SN	12.9	5.7	SN	19.2	6.1
PPM	SB	< 14.		SB	< 13.		SB	< 13.		SB	< 14.	
PPM	TE	< 15.		TE	< 14.		TE	< 15.		TE	< 15.	
PPM	I	< 20.		I	< 19.		I	< 18.		I	< 19.	
PPM	CS	< 20.		CS	< 21.		CS	< 21.		CS	< 21.	
PPM	BA	964.	69.	BA	953.	68.	BA	917.	66.	BA	908.	65.
PPM	LA	48.	15.	LA	< 29.		LA	< 29.		LA	35.	15.
	CE	68.	18.	CE	< 38.		CE	41.	18.	CE	< 41.	

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		EL	1-4-A	+/-	EL	1-4-B	+/-	EL	1-5-A	+/-	EL	1-5-B	+/-
TI													
	%	AL	7.43	0.48	AL	7.19	0.46	AL	8.12	0.51	AL	8.00	0.51
	%	SI	30.0	1.5	SI	29.8	1.5	SI	27.1	1.4	SI	27.3	1.4
	%	P	0.130	0.038	P	0.129	0.036	P	0.225	0.041	P	0.208	0.042
	%	S	0.034	0.015	S	< 0.027		S	0.039	0.015	S	0.055	0.016
	%	CL	< 0.012		CL	0.022	0.007	CL	< 0.013		CL	< 0.013	
	%	K	1.592	0.081	K	1.559	0.079	K	1.368	0.069	K	1.371	0.070
	%	CA	2.96	0.15	CA	2.87	0.14	CA	3.83	0.19	CA	3.98	0.20
	%	TI	0.611	0.031	TI	0.582	0.029	TI	0.735	0.037	TI	0.751	0.038
	PPM	V	113.	13.	V	102.	13.	V	141.	15.	V	159.	16.
	PPM	CR	87.1	5.7	CR	87.2	5.7	CR	217.	12.	CR	205.	11.
CR				+/-			+/-			+/-			+/-
	%	AL	8.1	1.7	AL	6.2	1.4	AL	6.7	1.8	AL	9.5	1.8
	%	SI	28.3	1.9	SI	29.0	1.8	SI	26.8	1.8	SI	26.4	1.8
	PPM	MN	666.	44.	MN	627.	41.	MN	855.	54.	MN	881.	56.
	%	FE	3.91	0.20	FE	3.63	0.18	FE	4.94	0.25	FE	5.02	0.25
	PPM	CO	< 79.		CO	< 73.		CO	< 90.		CO	< 91.	
	PPM	NI	83.5	7.5	NI	86.7	7.1	NI	277.	17.	NI	279.	17.
	PPM	CU	718.	38.	CU	685.	36.	CU	2720.	140.	CU	2630.	130.
	PPM	ZN	70.5	5.5	ZN	70.1	5.4	ZN	103.9	8.0	ZN	105.6	8.1
	PPM	GA	17.5	2.4	GA	19.6	2.3	GA	33.2	3.3	GA	34.7	3.4
	PPM	HG	< 6.1		HG	< 5.4		HG	9.0	3.5	HG	< 7.0	
	PPM	SE	< 2.0		SE	< 1.9		SE	< 2.1		SE	< 2.1	
	PPM	PB	30.8	3.6	PB	30.6	3.7	PB	53.9	4.7	PB	56.2	4.8
	PPM	AS	< 4.0		AS	< 3.8		AS	< 4.8		AS	8.2	2.6
	PPM	BR	< 2.0		BR	< 2.0		BR	< 2.2		BR	< 2.2	
[illegible]				+/-			+/-			+/-			+/-
	PPM	RB	55.7	4.3	RB	55.1	4.3	RB	66.4	5.5	RB	57.6	5.6
	PPM	U	321.	23.	U	337.	24.	U	1156.	81.	U	1152.	81.
	PPM	SR	377.	26.	SR	405.	28.	SR	380.	27.	SR	374.	26.
	PPM	Y	32.0	2.5	Y	32.0	2.5	Y	30.0	2.5	Y	30.0	2.4
	PPM	ZR	278.	20.	ZR	289.	20.	ZR	936.	66.	ZR	943.	66.
	PPM	NB	7.3	1.1	NB	8.1	1.1	NB	10.3	1.5	NB	10.3	1.5
	PPM	MO	< 2.3		MO	< 2.4		MO	< 3.7		MO	< 3.5	
AM				+/-			+/-			+/-			+/-
	PPM	RU	< 6.5		RU	< 7.7		RU	< 7.1		RU	< 6.9	
	PPM	RH	< 7.4		RH	< 8.6		RH	< 7.5		RH	< 7.2	
	PPM	PD	< 8.2		PD	< 9.6		PD	< 7.7		PD	< 7.7	
	PPM	AG	< 8.6		AG	10.6	5.2	AG	19.9	4.4	AG	20.7	4.1
	PPM	CD	< 9.3		CD	< 11.		CD	< 8.8		CD	< 8.7	
	PPM	IN	< 11.		IN	< 12.		IN	< 9.2		IN	10.2	4.5
	PPM	SN	< 11.		SN	< 13.		SN	55.7	6.6	SN	45.7	6.1
	PPM	SB	< 13.		SB	< 16.		SB	< 12.		SB	< 12.	
	PPM	TE	< 15.		TE	< 16.		TE	< 14.		TE	< 13.	
	PPM	I	< 18.		I	< 21.		I	< 17.		I	< 15.	
	PPM	CS	< 20.		CS	< 23.		CS	< 20.		CS	< 22.	
	PPM	BA	918.	66.	BA	954.	69.	BA	1096.	78.	BA	1029.	73.
	PPM	LA	31.	14.	LA	32.	16.	LA	45.	13.	LA	53.	13.
	PPM	CE	69.	20.	CE	53.	23.	CE	70.	18.	CE	48.	19.

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	EL	1-6-A	+/-		1-6-B	+/-		1-7-A	+/-		1-7-B	+/-
TI												
%	AL	9.24	0.56	AL	7.73	0.50	AL	10.23	0.61	AL	10.52	0.62
%	SI	22.7	1.2	SI	20.5	1.1	SI	17.53	0.90	SI	10.48	0.95
%	P	0.353	0.045	P	0.319	0.045	P	0.445	0.047	P	0.409	0.047
%	S	0.039	0.016	S	0.045	0.017	S	0.077	0.017	S	0.072	0.017
%	CL	< 0.013		CL	< 0.014		CL	< 0.013		CL	< 0.013	
%	K	1.177	0.060	K	1.164	0.059	K	1.082	0.055	K	1.050	0.054
%	CA	4.63	0.23	CA	4.53	0.23	CA	4.12	0.21	CA	4.07	0.20
%	TI	0.713	0.036	TI	0.683	0.034	TI	0.541	0.027	TI	0.540	0.027
PPM	V	143.	15.	V	131..	15.	V	< 23.		V	28.	12.
PPM	CR	365.	19.	CR	376.	20.	CR	606.	31.	CR	614.	31.
CR			+/-			+/-			+/-			+/-
%	AL	8.5	1.8	AL	12.1	1.9	AL	7.2	1.9	AL	13.8	1.8
%	SI	21.4	1.6	SI	20.0	1.6	SI	16.5	1.4	SI	18.3	1.4
PPM	MN	826.	53.	MN	826.	53.	MN	631.	44.	MN	674.	45.
%	FE	4.82	0.24	FE	4.70	0.24	FE	3.63	0.18	FE	3.60	0.18
PPM	CO	< 89.		CO	< 88.		CO	< 74.		CO	< 72.	
PPM	NI	485.	28.	NI	515.	29.	NI	765.	41.	NI	748.	40.
PPM	CU	5010.	250.	CU	4950.	250.	CU	6660.	330.	CU	6730.	340.
PPM	ZN	137.	10.	ZN	123.1	9.6	ZN	187.	12.	ZN	180.	12.
PPM	GA	40.4	4.1	GA	47.2	4.1	GA	54.7	4.5	GA	58.0	4.6
PPM	HG	< 7.5		HG	8.4	3.7	HG	7.6	3.5	HG	8.6	3.6
PPM	SE	< 2.2		SE	< 2.2		SE	< 2.2		SE	< 2.2	
PPM	PB	95.7	6.7	PB	93.3	6.4	PB	133.5	8.4	PB	130.2	8.3
PPM	AS	< 5.8		AS	< 5.7		AS	9.1	3.4	AS	10.5	3.4
PPM	BR	< 2.5		BR	< 2.4		BR	< 2.8		BR	< 2.8	
-E			+/-			+/-			+/-			+/-
PPM	RB	87.1	7.3	RB	90.1	7.4	RB	150.	12.	RB	155.	13.
PPM	U	2110.	150.	U	2150.	150.	U	5460.	380.	U	5620.	390.
PPM	SR	366.	26.	SR	370.	26.	SR	414.	29.	SR	417.	29.
PPM	Y	28.0	2.6	Y	25.1	2.3	Y	24.2	2.8	Y	29.7	3.1
PPM	ZR	1670.	120.	ZR	1680.	120.	ZR	2700.	190.	ZR	2780.	190.
PPM	NB	13.7	2.0	NB	7.1	1.6	NB	< 4.9		NB	< 5.2	
PPM	MO	< 5.4		MO	< 4.6		MO	< 8.9		MO	< 9.4	
HM			+/-			+/-			+/-			+/-
PPM	RU	< 9.5		RU	< 7.1		RU	< 10.		RU	< 11.	
PPM	RH	< 10.0		RH	< 7.4		RH	< 11.		RH	< 12.	
PPM	PD	< 9.5		PD	< 7.0		PD	< 9.9		PD	< 11.	
PPM	AG	47.2	5.8	AG	40.7	4.7	AG	69.6	6.8	AG	74.9	7.1
PPM	CD	< 10.		CD	< 8.2		CD	< 9.3		CD	< 10.	
PPM	IN	< 11.		IN	< 8.3		IN	< 9.7		IN	< 11.	
PPM	SN	69.4	8.0	SN	69.4	6.9	SN	138.	11.	SN	152.	12.
PPM	SB	< 13.		SB	< 11.		SB	< 12.		SB	< 13.	
PPM	TE	< 16.		TE	< 12.		TE	< 14.		TE	< 16.	
PPM	I	< 20.		I	< 15.		I	< 18.		I	20.8	10.0
PPM	CS	< 24.		CS	< 19.		CS	< 22.		CS	< 22.	
PPM	BA	1324.	94.	BA	1321.	94.	BA	2370.	170.	BA	2430.	170.
	LA	< 31.		LA	< 24.		LA	45.	14.	LA	< 32.	
	CE	90.	21.	CE	59.	16.	CE	79.	19.	CE	75.	22.

[illegible]S	EL	BCR-1+200PPM U	+/-	EL	USGS BCR-1	+/-
TI						
[illegible]	AL	7.14	0.49	AL		
%	SI	25.4	1.3	SI		
%	P	0.182	0.044	P		
%	S	0.091	0.018	S		
%	CL	< 0.015		CL		
%	K	1.407	0.071	K		
%	CA	4.95	0.25	CA		
%	TI	1.314	0.066	TI		
PPM	V	407.	27.	V		
PPM	CR	< 8.9		CR		
[illegible]R						
%	AL	6.3	2.0	AL	7.2	1.7
%	SI	24.5	1.8	SI	25.5	1.7
PPM	MN	1415.	85.	MN	1400.	83.
%	FE	9.33	0.47	FE	9.19	0.46
PPM	CO	< 140.		CO	< 130.	
PPM	NI	35.5	6.5	NI	16.7	5.5
PPM	CU	26.0	4.2	CU	19.3	3.8
PPM	ZN	125.3	8.4	ZN	125.2	8.3
PPM	GA	21.6	3.1	GA	19.4	2.8
PPM	HG	< 9.0		HG	< 8.1	
[illegible]	SE	< 2.6		SE	< 2.5	
PPM	PB	12.2	3.8	PB	12.5	3.7
PPM	AS	< 4.6		AS	< 4.3	
PPM	BR	< 2.4		BR	< 2.4	
[illegible]						
PPM	RB	47.0	3.8	RB		
PPM	U	196.	14.	U		
PPM	SR	330.	23.	SR		
PPM	Y	38.9	2.9	Y		
PPM	ZR	190.	13.	ZR		
PPM	NB	9.9	1.1	NB		
PPM	MO	-4.8	1.0	MO		
[illegible]						
PPM	RU	< 4.6		RU	< 7.1	
PPM	RH	< 5.0		RH	< 7.7	
PPM	PD	< 5.7		PD	< 8.3	
PPM	AG	< 6.2		AG	< 9.5	
PPM	CD	9.4	3.5	CD	< 11.	
PPM	IN	< 7.2		IN	< 11.	
PPM	SN	< 8.2		SN	< 13.	
PPM	SB	< 9.3		SB	< 14.	
PPM	TE	< 11.		TE	< 18.	
PPM	I	< 13.		I	< 20.	
PPM	CS	< 15.		CS	< 22.	
PPM	BA	668.	48.	BA	687.	51.
PPM	LA	< 23.		LA	< 33.	
PPM	CE	69.	16.	CE	< 44.	

X-RAY FLUORESCENCE ANALYSIS

Final Report

SPONSOZ: GINNY LEGORE
DATE OF WORK: 10-15-93
WORK ORDER NUMBER: K16853 IMPACT LEVEL III
TYPE OF MATERIAL: SOILS FROM 300 AREA

SERIES NAMES ASSOCIATED WITH THIS SAMPLE SET:
FZ2GX2
Z2GLX2
H2GLX2
GGLX02
FZ2GX2
Z2GLX2
H2GLX2
GGLX02

9413273.0129

DESCRIPTION OF XRFA TECHNIQUES USED

SAMPLES WERE PROCESSED BY THE NORMAL METHOD FOR LOOSE POWDER PACKAGED SAMPLES. SAMPLES PROCESSED IN COMPLIANCE WITH PNL TEST PROCEDURE ALO 266.

ANALYST: RON SANDERS 10-27-93 REVIEW: 10/27/93
PHONE: 376-3877

UNITS	EL	USGS AGV-1	+/-	EL	SRM 1646	+/-	EL	300-2-1A	+/-	EL	300-2-1B	+/-
%	AL	9.09	0.52	AL	6.69	0.41	AL	6.39	0.41	AL	6.41	0.41
%	SI	29.1	1.5	SI	30.5	1.5	SI	26.2	1.3	SI	25.7	1.3
%	P	< 0.072		P	< 0.059		P	< 0.080		P	< 0.078	
%	S	0.026	0.011	S	1.171	0.063	S	0.043	0.013	S	0.063	0.013
%	CL	< 0.010		CL	1.624	0.083	CL	< 0.010		CL	< 0.010	
%	K	2.40	0.12	K	2.21	0.11	K	1.357	0.068	K	1.354	0.068
%	CA	3.47	0.17	CA	0.873	0.044	CA	4.90	0.25	CA	4.93	0.25
%	TI	0.752	0.038	TI	0.530	0.027	TI	1.337	0.067	TI	1.340	0.067
PPM	V	143.	13.	V	156.	11.	V	437.	26.	V	436.	26.
PPM	CR	< 5.7		CR	91.1	5.3	CR	19.2	3.5	CR	18.2	3.4
			+/-			+/-			+/-			+/-
PPM	MN	690.	38.	MN	328.	20.	MN	1643.	86.	MN	1625.	85.
%	FE	4.47	0.22	FE	3.30	0.17	FE	8.61	0.43	FE	8.36	0.42
PPM	NI	20.4	2.4	NI	33.7	2.8	NI	17.4	3.4	NI	23.3	3.3
PPM	CU	64.6	4.0	CU	16.1	1.7	CU	121.1	7.0	CU	118.2	6.8
PPM	ZN	87.7	4.9	ZN	126.9	6.7	ZN	124.1	6.8	ZN	125.1	6.9
PPM	GA	18.5	1.5	GA	13.6	1.2	GA	17.9	1.6	GA	19.3	1.6
PPM	HG	< 4.5		HG	< 3.9		HG	< 5.0		HG	< 5.0	
PPM	SE	< 1.2		SE	< 1.0		SE	< 1.2		SE	1.31	0.61
PPM	PB	35.7	2.5	PB	27.2	2.0	PB	6.4	1.8	PB	9.7	1.8
PPM	AS	< 1.9		AS	11.5	1.0	AS	4.8	1.0	AS	2.22	0.97
PPM	BR	< 1.3		BR	136.3	7.0	BR	< 1.5		BR	< 1.5	
			+/-			+/-			+/-			+/-
PPM	RB	65.1	4.7	RB	82.4	6.0	RB	41.6	3.3	RB	40.2	3.2
PPM	U	< 5.3		U	< 5.3		U	12.7	2.9	U	< 5.3	
PPM	SR	645.	45.	SR	147.	10.	SR	321.	23.	SR	323.	23.
PPM	Y	16.6	1.5	Y	27.1	2.1	Y	37.4	2.8	Y	37.5	2.9
PPM	ZR	221.	16.	ZR	397.	28.	ZR	192.	14.	ZR	185.	13.
PPM	NB	13.0	1.2	NB	13.0	1.2	NB	14.9	1.4	NB	14.6	1.4
PPM	MO	2.66	0.97	MO	4.2	1.1	MO	2.25	0.99	MO	2.1	1.0
			+/-			+/-			+/-			+/-
PPM	RU	< 9.5		RU	< 9.9		RU	< 8.7		RU	< 9.3	
PPM	RH	< 10.		RH	< 11.		RH	< 9.6		RH	< 9.8	
PPM	PD	< 12.		PD	< 12.		PD	< 11.		PD	< 12.	
PPM	AG	< 12.		AG	< 13.		AG	< 12.		AG	< 12.	
PPM	CD	< 13.		CD	< 14.		CD	< 13.		CD	< 13.	
PPM	IN	< 14.		IN	< 15.		IN	< 14.		IN	< 14.	
PPM	SN	15.7	7.1	SN	< 15.		SN	< 14.		SN	< 15.	
PPM	SB	21.0	7.7	SB	< 16.		SB	< 15.		SB	< 16.	
PPM	TE	< 18.		TE	< 17.		TE	< 17.		TE	< 18.	
PPM	I	< 22.		I	46.	11.	I	< 19.		I	< 22.	
PPM	CS	< 27.		CS	< 25.		CS	< 25.		CS	< 25.	
PPM	BA	1243.	68.	BA	429.	31.	BA	814.	47.	BA	773.	44.
PPM	LA	47.	23.	LA	< 45.		LA	< 43.		LA	88.	22.
PPM	CE	< 57.		CE	< 57.		CE	< 54.		CE	< 56.

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UNITS	EL	300-2-3A	+/-
%	AL	7.12	0.44
%	SI	25.4	1.3
%	P	< 0.077	
%	S	0.034	0.012
%	CL	< 0.010	
%	K	1.116	0.056
%	CA	4.89	0.25
%	TI	1.368	0.069
PPM	V	472.	27.
PPM	CR	38.8	3.8
PPM	MN	1366.	72.
%	FE	8.48	0.42
PPM	NI	37.2	3.8
PPM	CU	282.	15.
PPM	ZN	121.7	6.7
PPM	GA	19.6	1.6
PPM	HG	< 4.9	
PPM	SE	< 1.2	
PPM	PB	7.1	1.8
PPM	AS	2.48	0.95
PPM	BR	< 1.4	
PPM	RB	29.5	2.5
PPM	U	9.8	2.6
PPM	SR	382.	21.
PPM	Y	34.6	2.6
PPM	ZR	199.	14.
PPM	NB	12.4	1.2
PPM	MO	< 2.8	
PPM	RU	< 18.	
PPM	RH	< 11.	
PPM	PD	< 13.	
PPM	AG	< 14.	
PPM	CD	< 14.	
PPM	IN	< 15.	
PPM	SN	< 16.	
PPM	SB	< 18.	
PPM	TE	< 28.	
PPM	I	< 24.	
PPM	CS	< 27.	
PPM	BA	654.	48.
PPM	LA	< 47.	
PPM	CE	< 61.	

EL	300-2-3B	+/-
AL	7.85	0.44
SI	26.2	1.3
P	0.182	0.048
S	0.051	0.012
CL	< 0.018	
K	1.134	0.057
CA	4.97	0.25
TI	1.379	0.069
V	451.	26.
CR	39.8	3.9
MN	1428.	75.
FE	8.88	0.44
NI	34.9	3.9
CU	317.	17.
ZN	128.1	7.1
GA	28.1	1.7
HG	< 5.1	
SE	< 1.3	
PB	< 3.5	
AS	5.8	1.8
BR	< 1.5	
RB	32.6	2.8
U	8.9	2.7
SR	328.	22.
Y	37.1	2.8
ZR	283.	14.
NB	13.2	1.3
MO	< 2.8	
RU	< 9.1	
RH	< 18.	
PD	< 12.	
AG	< 12.	
CD	< 13.	
IN	< 14.	
SN	< 15.	
SB	< 15.	
TE	< 16.	
I	< 28.	
CS	< 26.	
BA	633.	38.
LA	< 42.	
CE	< 55.	

EL	300-2-5A	+/-
AL	6.88	0.44
SI	24.8	1.3
P	< 0.088	
S	0.035	0.013
CL	< 0.011	
K	1.886	0.055
CA	4.63	0.23
TI	1.338	0.067
V	441.	26.
CR	33.4	3.8
MN	1375.	73.
FE	8.62	0.43
NI	44.1	4.3
CU	733.	38.
ZN	131.7	7.3
GA	28.8	1.7
HG	< 5.8	
SE	1.32	0.62
PB	4.5	1.8
AS	6.1	1.8
BR	< 1.5	
RB	35.6	2.9
U	24.5	3.1
SR	334.	23.
Y	35.1	2.7
ZR	231.	16.
NB	12.8	1.2
MO	< 1.9	
RU	< 8.8	
RH	< 18.	
PD	< 11.	
AG	< 12.	
CD	< 13.	
IN	< 14.	
SN	< 14.	
SB	< 15.	
TE	< 16.	
I	24.1	9.8
CS	< 26.	
BA	613.	38.
LA	< 42.	
CE	< 54.	

EL	300-2-5B	+/-
AL	6.88	0.48
SI	23.2	1.2
P	0.117	0.038
S	0.041	0.011
CL	< 0.018	
K	1.833	0.052
CA	4.44	0.22
TI	1.383	0.065
V	455.	26.
CR	33.6	3.6
MN	1346.	71.
FE	8.35	0.42
NI	48.6	4.3
CU	699.	36.
ZN	125.9	7.8
GA	23.3	1.8
HG	< 5.8	
SE	< 1.3	
PB	9.2	1.9
AS	3.47	0.99
BR	< 1.5	
RB	31.4	2.7
U	18.8	2.9
SR	321.	23.
Y	34.6	2.6
ZR	229.	16.
NB	18.8	1.2
MO	2.4	1.8
RU	< 11.	
RH	< 12.	
PD	< 14.	
AG	< 14.	
CD	22.3	7.3
IN	< 16.	
SN	< 17.	
SB	< 18.	
TE	< 28.	
I	< 24.	
CS	< 28.	
BA	614.	41.
LA	63.	25.
CE	< 61.	

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9413273.0132

UNITS	EL	300-2-7A	+/-	EL	300-2-7B	+/-	EL	300-2-9A	+/-	EL	300-2-9B	+/-
%	AL	5.80	0.39	AL	6.82	0.40	AL	6.27	0.40	AL	6.54	0.43
%	SI	26.2	1.3	SI	27.1	1.4	SI	25.2	1.3	SI	27.1	1.4
%	P	< 0.068		P	< 0.072		P	< 0.065		P	< 0.074	
%	S	0.036	0.010	S	0.036	0.011	S	0.035	0.010	S	0.029	0.012
%	CL	< 0.009		CL	< 0.010		CL	< 0.009		CL	< 0.010	
%	K	1.320	0.067	K	1.360	0.069	K	1.290	0.065	K	1.385	0.070
%	CA	3.35	0.17	CA	3.44	0.17	CA	3.00	0.15	CA	3.39	0.17
%	TI	0.939	0.047	TI	0.982	0.049	TI	0.908	0.046	TI	0.995	0.050
PPM	V	303.	19.	V	310.	19.	V	296.	18.	V	325.	20.
PPM	CR	81.2	5.1	CR	88.9	5.4	CR	106.9	6.1	CR	107.6	6.3
			+/-			+/-			+/-			+/-
PPM	MN	1022.	55.	MN	1065.	57.	MN	1027.	55.	MN	1158.	62.
%	FE	6.13	0.31	FE	6.13	0.31	FE	6.49	0.33	FE	6.97	0.35
PPM	NI	63.9	4.6	NI	58.3	4.4	NI	64.5	4.8	NI	68.0	5.0
PPM	CU	1049.	53.	CU	945.	48.	CU	1005.	51.	CU	1066.	54.
PPM	ZN	130.7	7.2	ZN	127.7	7.0	ZN	149.7	8.2	ZN	141.9	7.8
PPM	GA	19.7	1.7	GA	19.2	1.6	GA	20.0	1.7	GA	19.6	1.7
PPM	HG	< 4.9		HG	< 4.5		HG	< 5.1		HG	< 4.8	
PPM	SE	< 1.2		SE	< 1.1		SE	< 1.4		SE	< 1.2	
PPM	PB	15.9	2.0	PB	18.7	1.9	PB	19.4	2.3	PB	21.2	2.0
PPM	AS	4.26	1.00	AS	3.28	0.93	AS	4.8	1.1	AS	6.2	1.0
PPM	BR	< 1.5		BR	< 1.4		BR	< 1.7		BR	< 1.4	
			+/-			+/-			+/-			+/-
PPM	RB	52.8	4.2	RB	51.9	4.0	RB	51.4	4.1	RB	56.7	4.3
PPM	U	85.6	6.8	U	79.3	6.2	U	80.1	6.6	U	91.9	7.0
PPM	SR	375.	26.	SR	365.	26.	SR	341.	24.	SR	348.	24.
PPM	Y	37.3	2.9	Y	33.6	2.6	Y	34.1	2.7	Y	35.5	2.7
PPM	ZR	522.	37.	ZR	511.	36.	ZR	552.	39.	ZR	561.	39.
PPM	NB	11.2	1.4	NB	10.7	1.2	NB	13.8	1.6	NB	13.0	1.3
PPM	MO	3.4	1.5	MO	4.1	1.2	MO	< 3.3		MO	4.1	1.2
			+/-			+/-			+/-			+/-
PPM	RU	< 13.		RU	< 8.3		RU	< 14.		RU	< 7.2	
PPM	RH	< 13.		RH	< 9.3		RH	< 16.		RH	15.3	3.8
PPM	PD	< 16.		PD	< 11.		PD	< 17.		PD	< 9.2	
PPM	AG	17.8	8.5	AG	11.9	5.6	AG	< 17.		AG	14.2	4.9
PPM	CD	< 18.		CD	< 12.		CD	< 19.		CD	< 11.	
PPM	IN	< 19.		IN	< 13.		IN	< 21.		IN	< 11.	
PPM	SN	< 20.		SN	22.0	6.7	SN	30.	11.	SN	27.2	6.0
PPM	SB	< 21.		SB	< 14.		SB	< 22.		SB	< 13.	
PPM	TE	< 22.		TE	< 16.		TE	< 23.		TE	< 14.	
PPM	I	< 26.		I	< 20.		I	< 29.		I	< 17.	
PPM	CS	< 34.		CS	< 24.		CS	< 37.		CS	< 21.	
PPM	BA	660.	43.	BA	679.	39.	BA	702.	40.	BA	663.	38.
PPM	LA	< 56.		LA	55.	19.	LA	93.	31.	LA	< 36.	
PPM	CE	97.	37.	CE	59.	22.	CE	< 79.		CE	85.	21.

UNITS	EL	300-2-11A	+/-	EL	SRM 1646	+/-	EL	USGS AGV-1	+/-	EL	USGS AGV-1	+/-
Ti Fe/Zr												
%	AL	6.70	0.44	AL	6.39	0.42	AL	8.35	0.49	AL	8.19	0.49
%	SI	26.2	1.3	SI	30.8	1.6	SI	27.6	1.4	SI	27.6	1.4
%	P	< 0.073		P	< 0.063		P	< 0.068		P	< 0.069	
%	S	0.043	0.011	S	1.120	0.061	S	< 0.020		S	0.023	0.010
%	CL	< 0.010		CL	1.496	0.077	CL	< 0.009		CL	< 0.010	
%	K	1.337	0.067	K	2.09	0.11	K	2.31	0.12	K	2.23	0.11
%	CA	3.46	0.17	CA	0.842	0.042	CA	3.20	0.16	CA	3.23	0.16
%	TI	1.052	0.053	TI	0.501	0.025	TI	0.624	0.031	TI	0.672	0.034
PPM	V	358.	22.	V	142.	11.	V	125.	12.	V	129.	12.
PPM	CR	118.0	6.8	CR	88.4	5.2	CR	< 5.3		CR	< 5.3	
CR			+/-			+/-			+/-			+/-
PPM	MN	1262.	67.	MN	347.	21.	MN	704.	38.	MN	705.	39.
%	FE	8.06	0.40	FE	3.34	0.17	FE	4.45	0.22	FE	4.44	0.22
PPM	NI	102.7	6.7	NI	31.7	2.8	NI	15.9	2.4	NI	14.4	2.3
PPM	CU	1454.	73.	CU	17.5	1.8	CU	56.6	3.7	CU	58.9	3.6
PPM	ZN	163.4	8.9	ZN	123.3	6.6	ZN	88.8	5.0	ZN	83.4	4.
PPM	GA	23.1	1.9	GA	13.0	1.2	GA	20.7	1.6	GA	19.4	1.
PPM	HG	< 5.0		HG	< 4.1		HG	< 4.6		HG	< 4.3	
PPM	SE	< 1.2		SE	< 1.0		SE	< 1.3		SE	< 1.1	
PPM	PB	30.0	2.3	PB	27.6	2.0	PB	41.0	2.9	PB	37.2	
PPM	AS	4.2	1.1	AS	11.1	1.0	AS	< 2.0		AS	< 1.8	
PPM	BR	< 1.5		BR	130.1	6.7	BR	< 1.5		BR	< 1.2	
AG			+/-			+/-			+/-			+/-
PPM	RB	55.9	4.3	RB	80.5	5.8	RB	69.8	5.1	RB	65.5	4.8
PPM	U	90.7	7.5	U	5.2	2.4	U	< 6.4		U	< 5.4	
PPM	SR	345.	24.	SR	140.2	9.9	SR	689.	40.	SR	665.	47.
PPM	Y	36.2	2.8	Y	26.6	2.1	Y	21.8	1.9	Y	18.3	1.6
PPM	ZR	680.	40.	ZR	392.	27.	ZR	233.	16.	ZR	226.	16.
PPM	NB	17.4	1.5	NB	12.9	1.2	NB	11.3	1.3	NB	12.3	1.2
PPM	MO	6.6	1.4	MO	3.62	0.93	MO	< 2.4		MO	2.34	0.97
Gd			+/-			+/-			+/-			+/-
PPM	RU	< 8.0		RU	< 7.2		RU	< 13.		RU	< 9.4	
PPM	RH	< 8.8		RH	< 8.0		RH	< 15.		RH	< 10.	
PPM	PD	< 9.9		PD	< 9.0		PD	< 16.		PD	< 12.	
PPM	AG	18.5	5.2	AG	< 9.4		AG	< 17.		AG	< 12.	
PPM	CD	< 12.		CD	< 10.		CD	< 17.		CD	< 13.	
PPM	IN	< 12.		IN	< 11.		IN	22.0	9.9	IN	< 14.	
PPM	SN	22.9	6.5	SN	< 11.		SN	< 21.		SN	< 15.	
PPM	SB	< 13.		SB	< 12.		SB	< 21.		SB	< 15.	
PPM	TE	< 15.		TE	< 14.		TE	< 24.		TE	< 18.	
PPM	I	< 19.		I	27.6	8.2	I	< 27.		I	< 22.	
PPM	CS	< 23.		CS	< 19.		CS	< 37.		CS	< 27.	
PPM	BA	679.	39.	BA	379.	25.	BA	1220.	70.	BA	1222.	66.
PPM	LA	86.	19.	LA	< 34.		LA	< 60.		LA	53.	22.
PPM	CE	104.	25.	CE	97.	22.	CE	< 66.		CE	< 50.	

UNITS	EL	SRM 1646	+/-	EL	300-2-11B	+/-	EL	300-2-13A	+/-	EL	300-2-13B	+/-
%	AL	5.27	0.38	AL	6.84	0.44	AL	9.10	0.54	AL	9.25	0.54
%	SI	28.8	1.5	SI	25.1	1.3	SI	23.5	1.2	SI	23.3	1.2
%	P	< 0.057		P	< 0.072		P	< 0.065		P	< 0.063	
%	S	1.005	0.055	S	0.026	0.012	S	0.044	0.011	S	0.049	0.011
%	CL	1.393	0.071	CL	< 0.010		CL	< 0.010		CL	< 0.009	
%	K	1.935	0.097	K	1.310	0.066	K	1.896	0.095	K	1.856	0.093
%	CA	0.804	0.041	CA	3.50	0.18	CA	2.31	0.12	CA	2.35	0.12
%	TI	0.461	0.023	TI	1.017	0.051	TI	0.680	0.035	TI	0.700	0.036
PPM	V	121.0	9.9	V	334.	20.	V	201.	14.	V	205.	14.
PPM	CR	83.6	4.8	CR	116.1	6.7	CR	194.	10.	CR	192.	10.
			+/-			+/-			+/-			+/-
PPM	MN	329.	20.	MN	1253.	66.	MN	1213.	64.	MN	1186.	62.
%	FE	3.34	0.17	FE	7.92	0.40	FE	5.98	0.30	FE	5.80	0.29
PPM	NI	35.3	2.9	NI	101.3	6.6	NI	187.	11.	NI	177.3	10.0
PPM	CU	15.4	1.6	CU	1395.	70.	CU	2360.	120.	CU	2260.	110.
PPM	ZN	131.1	7.0	ZN	170.8	9.2	ZN	185.7	10.0	ZN	184.3	9.9
PPM	GA	13.0	1.2	GA	24.0	1.9	GA	28.4	2.1	GA	29.3	2.1
PPM	HG	< 3.9		HG	< 4.9		HG	< 4.7		HG	< 4.6	
PPM	SE	< 1.0		SE	< 1.2		SE	< 1.1		SE	< 1.1	
PPM	PB	27.1	2.0	PB	22.1	2.1	PB	30.2	2.5	PB	37.5	2.5
PPM	AS	13.6	1.1	AS	8.0	1.1	AS	11.3	1.1	AS	9.6	1.1
PPM	BR	136.5	7.0	BR	< 1.4		BR	2.09	0.71	BR	< 1.4	
			+/-			+/-			+/-			+/-
PPM	RB	84.7	6.1	RB	54.1	4.2	RB	110.4	8.0	RB	107.6	7.8
PPM	U	< 5.3		U	93.8	7.2	U	188.	14.	U	185.	13.
PPM	SR	151.	11.	SR	349.	24.	SR	269.	19.	SR	265.	19.
PPM	Y	27.4	2.1	Y	36.2	2.8	Y	34.6	2.7	Y	34.6	2.7
PPM	ZR	399.	28.	ZR	708.	50.	ZR	980.	69.	ZR	963.	67.
PPM	NB	14.1	1.3	NB	14.5	1.4	NB	14.4	1.4	NB	14.3	1.4
PPM	MO	3.2	1.0	MO	6.2	1.3	MO	7.2	1.5	MO	4.9	1.5
			+/-			+/-			+/-			+/-
PPM	RU	< 9.7		RU	< 8.7		RU	< 9.0		RU	< 8.6	
PPM	RH	< 11.		RH	10.4	4.5	RH	22.9	5.2	RH	11.9	4.8
PPM	PD	< 12.		PD	< 9.6		PD	< 11.		PD	< 10.	
PPM	AG	< 12.		AG	23.9	5.4	AG	50.9	6.6	AG	46.3	6.0
PPM	CD	< 14.		CD	< 12.		CD	< 13.		CD	< 12.	
PPM	IN	< 15.		IN	< 13.		IN	< 14.		IN	< 13.	
PPM	SN	< 15.		SN	21.3	6.9	SN	< 15.		SN	20.8	7.0
PPM	SB	< 16.		SB	< 15.		SB	< 15.		SB	< 15.	
PPM	TE	< 17.		TE	< 15.		TE	< 16.		TE	< 16.	
PPM	I	43.	11.	I	< 19.		I	25.	11.	I	22.3	9.5
PPM	CS	< 25.		CS	< 24.		CS	< 24.		CS	< 23.	
PPM	BA	373.	29.	BA	667.	39.	BA	904.	51.	BA	887.	50.
PPM	LA	63.	22.	LA	< 39.		LA	52.	22.	LA	46.	21.
PPM	CE	94.	28.	CE	102.	26.	CE	118.	28.	CE	68.	26.

UNITS	EL	300-2-10A	+/-	EL	300-2-10B	+/-	EL	USGS BCR-1	+/-	EL	BCR-1 + 200PPM U	+/-
%	AL	6.91	0.45	AL	7.13	0.47	AL	7.01	0.44	AL	7.55	0.50
%	SI	24.7	1.2	SI	25.6	1.3	SI	26.0	1.3	SI	26.9	1.4
%	P	< 0.072		P	< 0.081		P	< 0.075		P	< 0.089	
%	S	0.030	0.011	S	0.035	0.013	S	0.053	0.012	S	0.066	0.015
%	CL	< 0.010		CL	< 0.011		CL	< 0.010		CL	< 0.012	
%	K	1.400	0.071	K	1.387	0.070	K	1.459	0.074	K	1.462	0.074
%	CA	3.91	0.20	CA	4.17	0.21	CA	4.46	0.22	CA	4.40	0.22
%	TI	1.087	0.054	TI	1.152	0.058	TI	1.311	0.066	TI	1.255	0.063
PPM	V	356.	21.	V	354.	22.	V	402.	28.	V	474.	28.
PPM	CR	44.9	3.8	CR	45.2	4.1	CR	7.4	3.3	CR	< 7.2	
			+/-			+/-			+/-			+/-
PPM	MN	1318.	78.	MN	1337.	78.	MN	1380.	73.	MN	1401.	74.
%	FE	7.64	0.38	FE	7.80	0.39	FE	9.39	0.47	FE	9.37	0.47
PPM	NI	51.4	4.3	NI	43.7	4.1	NI	15.8	3.2	NI	33.1	3.8
PPM	CU	353.	18.	CU	326.	17.	CU	16.5	2.8	CU	21.0	2.2
PPM	ZN	116.1	6.4	ZN	117.3	6.5	ZN	129.9	7.1	ZN	115.3	6.4
PPM	GA	19.6	1.6	GA	20.2	1.7	GA	20.7	1.7	GA	19.9	1.7
PPM	HG	< 4.9		HG	< 4.9		HG	< 5.3		HG	< 5.3	
PPM	SE	< 1.2		SE	< 1.2		SE	< 1.3		SE	< 1.3	
PPM	PB	10.8	1.8	PB	10.4	1.8	PB	12.4	2.1	PB	13.5	1.9
PPM	AS	5.76	1.00	AS	4.31	0.99	AS	< 2.1		AS	< 2.0	
PPM	BR	< 1.4		BR	< 1.4		BR	< 1.6		BR	< 1.5	
			+/-			+/-			+/-			+/-
PPM	RB	59.5	4.5	RB	58.9	4.4	RB	48.4	3.7	RB	52.0	4.2
PPM	U	13.9	2.9	U	14.9	2.9	U	< 5.9		U	215.	15.
PPM	SR	328.	23.	SR	337.	24.	SR	358.	25.	SR	357.	25.
PPM	Y	35.3	2.7	Y	33.9	2.6	Y	35.9	2.9	Y	42.0	3.2
PPM	ZR	252.	18.	ZR	248.	17.	ZR	194.	14.	ZR	214.	15.
PPM	NB	14.4	1.3	NB	12.2	1.2	NB	11.4	1.3	NB	11.7	1.3
PPM	MO	1.34	0.98	MO	< 1.8		MO	3.2	1.1	MO	4.1	1.2
			+/-			+/-			+/-			+/-
PPM	RU	< 9.5		RU	< 7.4		RU	< 11.		RU	8.1	3.4
PPM	RH	< 11.		RH	< 7.5		RH	< 13.		RH	17.2	3.6
PPM	PD	< 12.		PD	< 8.2		PD	< 14.		PD	< 7.9	
PPM	AG	< 12.		AG	8.9	4.5	AG	< 15.		AG	< 8.1	
PPM	CD	< 13.		CD	< 10.0		CD	< 16.		CD	15.1	4.4
PPM	IN	< 15.		IN	< 11.		IN	< 16.		IN	< 9.2	
PPM	SN	< 15.		SN	< 11.		SN	< 17.		SN	12.4	5.1
PPM	SB	< 16.		SB	< 12.		SB	< 18.		SB	< 11.	
PPM	TE	< 18.		TE	< 14.		TE	< 21.		TE	< 12.	
PPM	I	< 22.		I	< 16.		I	< 26.		I	< 15.	
PPM	CS	< 26.		CS	< 21.		CS	< 30.		CS	< 19.	
PPM	BA	719.	42.	BA	687.	38.	BA	707.	45.	BA	678.	38.
PPM	LA	53.	22.	LA	< 34.		LA	< 53.		LA	< 32.	
PPM	CE	68.	26.	CE	77.	20.	CE	78.	33.	CE	< 37.	

UNITS	EL	USGS AGV-1	+/-
%	AL	8.44	0.50
%	SI	27.6	1.4
%	P	< 0.069	
%	S	< 0.020	
%	CL	< 0.009	
%	K	2.31	0.12
%	CA	3.34	0.17
%	TI	0.626	0.031
PPM	V	112.	11.
PPM	CR	< 5.3	
			+/-
PPM	MN	695.	38.
%	FE	4.52	0.23
PPM	NI	16.7	2.4
PPM	CU	53.9	3.5
PPM	ZN	87.5	4.9
PPM	GA	19.0	1.6
PPM	HG	< 4.7	
PPM	SE	< 1.3	
PPM	PB	41.7	2.9
PPM	AS	< 2.0	
PPM	BR	< 1.5	
			+/-
PPM	RB	71.9	5.2
PPM	U	< 6.5	
PPM	SR	714.	50.
PPM	Y	18.5	1.8
PPM	ZR	237.	17.
PPM	NB	14.3	1.5
PPM	MO	< 2.4	
			+/-
PPM	RU	< 13.	
PPM	RH	< 15.	
PPM	PD	< 17.	
PPM	AG	< 17.	
PPM	CD	< 18.	
PPM	IN	< 19.	
PPM	SN	< 20.	
PPM	SB	< 21.	
PPM	TE	< 23.	
PPM	I	< 26.	
PPM	CS	< 34.	
PPM	BA	1208.	69.
PPM	LA	< 59.	
PPM	CE	75.	37.

APPENDIX C

XRF AND CHEMICAL ANALYSIS OF GREEN AND WHITE AGGLOMERATES

APPENDIX C
XRF AND CHEMICAL ANALYSIS OF GREEN AND WHITE AGGLOMERATES

The following data includes the chain of custody forms and raw XRF data for samples of the green and white agglomerates that were hand picked out of the campaign 1 and 2 size separates 1 to 2 mm and 2 to 9.5 mm. In order to improve the mineralogic determinations a complete chemical analysis and calculation of the oxide content of each element was performed. Several elements that are not measurable by XRF (Na, Mg) and some that are more accurately measured by AA (Al, Si, Fe, and Ca) were measured by atomic absorption after totally fusing an aliquot in lithium metaborate. Aliquots were also subjected to heating progressively from 105 to 300 to 500 and finally to 900°C to determine loss on ignition. This activity provides data on the amount of carbonate, hydrous oxide (hydroxide) and other volatile substances (organic matter, sulfide minerals etc.) that may be present. Raw data are provided because some information on minor elements is not provided in the main text but data are available herein.

Eight samples were submitted and measured only once. Sample designations are shown below:

AA Sample	XRF Sample	Text Designation
B1-1-G	B1 Green 1 mm	Campaign 1 - 1 to 2 mm - Green
B1-2-G	B1 Green 2 mm	Campaign 1 - 2 to 9.5 mm - Green
B1-1-W	B1 White 1 mm	Campaign 1 - 1 to 2 mm - White
B1-2-W	B1 White 2 mm	Campaign 1 - 2 to 9.5 mm - White
B2-1-G	B2 Green 1 mm	Campaign 2 - 1 to 2 mm - Green
B2-2-G	B2 Green 2 mm	Campaign 2 - 2 to 9.5 mm - Green
B2-1-W	B2 White 1 mm	Campaign 2 - 1 to 2 mm - White
B2-2-W	B2 White 2 mm	Campaign 2 - 2 to 9.5 mm - White

94113273.014

Chain of Custody /Analytical Request Form — No. ____

To: Ron Sanders Date: 8-24-93 WP#: m8765 7 Org: D7D35

Requested by: Ginny LeGore (name) [signature] (signature) 65019 (tel) P8-37 (mail stop)

Relinquished by: ____ Received by: ____ Date/Time: ____

Relinquished by: ____ Received by: ____ Date/Time: ____

Relinquished by: ____ Received by: ____ Date/Time: ____

Relinquished by: ____ Received by: ____ Date/Time: ____

Analysis Requested: Please provide XRF analysis for the ___ samples described below.

Identification #

Batch 1 1mm	Green		Batch 1 2mm	white
Batch 2 1mm	Green		Batch 2 2mm	white
Batch 1 1mm	white			
Batch 2 1mm	white			
Batch 1 2mm	Green			
Batch 2 2mm	Green			

Material Description:

Special Storage or Handling Requirements: ☐ None ☑ Other: radioactive low levels

Disposal of Samples: ☐ Discard ☐ Return ☐ Other:

Requested Reports/Additional Instructions:

QA Requirements: Impact Level I II III (indicate level) SOW# ____

____ QA Representative approval required for first COC/ARF

QA Rep. sign /date in series for internal work. Not required external work.

Results must be signed and dated by the analyst and reviewer, identifying the measuring and test equipment and the procedure used (including revision).

To the best of my knowledge, this work was accomplished in accordance with the requirements of this Analytical Request Form.

By: [signature] Date: 10-5-93

Responsible Analyst or Group Manager

RETURN THIS FORM OR A COPY TO THE REQUESTOR

The report/data furnished has been reviewed and to the best of my knowledge complies with the above request.

By: R. Jeff Serne for Ginny LeGore Date: 10-8-93

Requestor

GL993-AA.XLS

N.L. Abbey 10-5-93   R.W. Sanders 10-5-93

WP# M87657 Date: 10-04-93 Analyst: N L Abbey Review: R W Sanders													
	50	Si	2	0.56	Al	2	0.30	Mg	1	0.003	Na	3	0.07
	sample	Target	peak	wt. %	Target	peak	wt. %	Target	peak	wt. %	Target	peak	wt. %
	wt.	wt %	heigth	Si	wt %	heigth	Al	wt %	heigth	Mg	wt %	heigth	Na
USGS AGV-1 a	50	27.58	100	28.09	8.95	60	8.95	0.92	265	0.920	3.21	144	3.21
USGS AGV-1 b	50					62	9.25		265	0.920	3.21	144	3.21
USGS BCR-1 a	50	25.48	89	25.00	7.2	47	7.01	2.09	602	2.090	2.46	111	2.47
USGS BCR-1 b	50					46	6.86		602	2.090	2.46	111	2.47
USGS G-2 a	50	32.3	115	32.30	8.1	58	8.65	0.46	128	0.444	3.08	141	3.14
USGS G-2 b	50					53	7.91		128	0.444	3.08	141	3.14
B1-1MM GREEN	50		9	2.53		114	17.01		480	1.666		7	0.16
B2-1MM GREEN	27		9	4.68		58	16.02		311	1.999		7	0.29
B1-1MM WHITE	50		36	10.11		163	24.31		139	0.483		50	1.11
B2-1MM WHITE	50		4	1.12		196	29.24		102	0.354		25	0.56
B1-2MM WHITE	50		14	3.93		185	27.60		29	0.101		28	0.62
B2-2MM GREEN	50		23	6.46		96	14.32		725	2.517		27	0.60
B1-2MM GREEN	50		45	12.64		80	11.93		730	2.534		54	1.20
B2-2MM WHITE	50		4	1.12		219	32.67		11	0.038		19	0.42

	50	K	2	0.05	Ca	2	0.07	Fe	3	0.14
	sample	Target	peak	wt. %	Target	peak	wt. %	Target	peak	wt. %
	wt.	wt %	heigth	K	wt %	heigth	Ca	wt %	heigth	Fe
USGS AGV-1 a	50	2.4	90	2.40	3.5	102	3.50	4.73	99	4.73
USGS AGV-1 b	50	2.4	90	2.40	3.5	102	3.50	4.73	99	4.73
USGS BCR-1 a	50	1.41	50	1.33	4.95	143	4.91	9.37	195	9.32
USGS BCR-1 b	50	1.41	50	1.33	4.95	146	5.01	9.37	190	9.08
USGS G-2 a	50	3.74	143	3.81	1.35	41	1.41	1.86	39	1.86
USGS G-2 b	50	3.74	143	3.81	1.35	39	1.34	1.86	40	1.91
B1-1MM GREEN	50		0	0.00		155	5.32		10	0.48
B2-1MM GREEN	27		0	0.00		85	5.40		4	0.35
B1-1MM WHITE	50		0	0.00		59	2.02		8	0.38
B2-1MM WHITE	50		0	0.00		45	1.54		0	0.00
B1-2MM WHITE	50		0	0.00		53	1.82		3	0.14
B2-2MM GREEN	50		0	0.00		195	6.69		35	1.67
B1-2MM GREEN	50		0	0.00		180	6.18		37	1.77
B2-2MM WHITE	50		0	0.00		2	0.07		5	0.24

GLMB.XLS

WP#m87657 Date: 10-4-93 Analyst: N.L. Abbey Review: R.W. Sanders

ELEMENT	oxide con factor	B1-1-G ppm solid	B1-1-G % oxide	B2-1-G Wt% total ppm solid	B2-1-G % oxide	B1-1-W ppm solid	B1-1-W % oxide	B2-1-W Wt% total ppm solid	B2-1-W % oxide	B1-2-W Wt% total ppm solid	B1-2-W % oxide	B2-2-G Wt% total ppm solid	B2-2-G % oxide	B1-2-G Wt% total ppm solid	B1-2-G % oxide	B2-2-W Wt% total ppm solid	B2-2-W % oxide
Na AA	1.348	1600	0.22	2900	0.39	11100	1.50	5600	0.76	6200	0.84	6000	0.81	12000	1.62	4200	0.87
Mg AA	1.6581	16680	2.76	19999	3.32	4830	0.80	3540	0.59	1010	0.17	25170	4.17	25340	4.20	380	0.06
Al AA	1.8895	170100	32.14	160200	30.27	243100	45.93	292400	55.25	276000	52.15	143200	27.06	119300	22.54	326700	61.73
Si AA	2.1393	25300	5.41	46800	10.01	101000	21.61	11120	2.38	39300	8.41	64800	13.82	126400	27.04	11200	2.40
K xrf	1.2046	1300	0.16	1220	0.15	2420	0.29	530	0.06	720	0.09	2230	0.27	3270	0.39	130	0.02
CaAA	1.3992	53200	7.44	54000	7.56	20200	2.83	15400	2.15	18200	2.55	66900	9.36	61800	8.65	700	0.10
Ti xrf	1.6681	290	0.05	230	0.04	330	0.06	150	0.03	170	0.03	670	0.11	990	0.17	0	0.00
Cr xrf	1.4616	1272	0.19	831	0.12	140	0.02	45	0.01	34	0.00	1690	0.25	1610	0.24	24	0.00
Mnxrf	1.2912	349	0.06	430	0.06	46	0.01	0	0.00	0	0.00	471	0.06	408	0.06	0	0.00
Fe AA	1.3508	4850	0.66	3500	0.47	3800	0.51	1100	0.15	1400	0.19	16700	2.26	17700	2.39	370	0.05
Ni xrf	1.2725	2500	0.32	1880	0.24	197	0.03	65	0.01	9	0.00	3170	0.40	2490	0.32	16	0.00
Cuxrf	1.2518	61900	7.75	60700	7.60	1372	0.17	1092	0.14	122	0.02	45000	5.63	34700	4.34	271	0.03
Znxrf	1.2448	312	0.04	182	0.02	42	0.01	31	0.00	35	0.00	389	0.05	359	0.04	34	0.00
Pbxrf	1.1545	260	0.03	143	0.02	47	0.01	43	0.00	33	0.00	325	0.04	298	0.03	31	0.00
Srxrf	1.1826	225	0.03	136	0.02	201	0.02	43	0.01	68	0.01	267	0.03	297	0.04	22	0.00
Zrxrf	1.3508	13720	1.85	11740	1.59	702	0.09	242	0.03	64	0.01	20100	2.72	18800	2.54	97	0.01
Nbxrf	1.4305	0	0.00	0	0.00	7	0.00	0	0.00	0	0.00	49	0.01	21	0.00	3	0.00
Moxrf	1.5003	61	0.01	0	0.00	0	0.00	0	0.00	0	0.00	38	0.01	0	0.00	0	0.00
Agxrf	1.0742	166	0.02	166	0.02	32	0.00	0	0.00	0	0.00	267	0.03	208	0.02	0	0.00
Cdxrf	1.1424	0	0.00	32	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Snxrf	1.1348	371	0.04	449	0.05	61	0.01	0	0.00	52	0.01	442	0.05	408	0.05	0	0.00
Csxrf	1.0602	0	0.00	0	0.00	0	0.00	68	0.01	0	0.00	0	0.00	0	0.00	0	0.00
Baxrf	1.1165	296	0.03	272	0.03	335	0.04	0	0.00	125	0.01	362	0.04	489	0.05	0	0.00
Laxrf	1.1728	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Cexrf	1.2284	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	137	0.02	175	0.02	0	0.00
Uxrf	1.1793	14800	1.75	12120	1.43	1630	0.19	1363	0.16	858	0.10	18500	2.18	13570	1.60	533	0.06
LOI900c			33.92	est	36.61		27.24		37.96		31.47		29.59		22.24		34.71
Wt.% total			94.85		100.00		101.36		99.69		96.05		98.96		98.59		99.76

GLLOI.XLS

10-5-93 10-5-93

WP#M87657		'10-4-93		Analyst: N.L.. Abbey			Review: R.W. Sanders								
SAMPLES	DISH	TARE	Received	105 C	300 C	500 C	900 C	AIR DRY	105 C	300 C	500 C	900 C	SUM	TOTAL	DISH
								GRAMS	%	%	%	%	%	900C %	
B1-green 1mm	1	18.9365	18.9839	18.9806	18.9745	18.9725	18.9685	0.0454	7.27	13.44	4.41	8.81	33.92	33.92	1
B2-green 1mm														*36.61*	est.
B1-white 1mm	III	19.1408	19.5821	19.5772	19.4876	19.4730	19.4619	0.4413	1.11	20.30	3.31	2.52	27.24	27.24	III
B2-white 1mm		18.9798	19.0151				19.0017	0.0353						37.96	
B1-white 2mm	b7	19.1799	20.1813	20.1773	19.9360	19.8875	19.8662	1.0014	0.40	24.10	4.84	2.13	31.47	31.47	b7
B2-green 2mm	6	19.1680	19.5354	19.5127	19.4621	19.4467	19.4267	0.3674	6.18	13.77	4.19	5.44	29.59	29.59	6
B1-green 2mm	12	19.3294	20.3332	20.2927	20.1956	20.1569	20.1100	1.0038	4.03	9.67	3.86	4.67	22.24	22.24	12
B2-white 2mm	8	19.1471	19.6991	19.6967	19.5383	19.5112	19.5075	0.552	0.43	28.70	4.91	0.67	34.71	34.71	8

X-RAY FLUORESCENCE ANALYSIS

Final Report
Pg 526 - 532
NJA
10-5-93

SPONSOR: GINNY LE GORE
DATE OF WORK: 9-29-93
WORK ORDER NUMBER: M87657
TYPE OF MATERIAL: EN AND WHITE-BATCHES 1 AND 2

SERIES NAMES ASSOCIATED WITH THIS SAMPLE SET:
FAGL91
ZGL901
AGL901
GGL901

DESCRIPTION OF XRFA TECHNIQUES USED

NORMAL PROCESSING OF SAMPLES EXCEPT FOR DOUBLE CONTAINMENT AND SAMPLE WEIGHT INPUT. WEIGHTS OF THE SAMPLES WERE TYPED IN BECAUSE SOME OF THE SAMPLES DID NOT HAVE ENOUGH MATERIAL TO PROVIDE ACCURATE MASS COMPUTATION BY THE SAP3 CODE. THESE OPTIONS ARE PRESENTED IN THE CODE DOCUMENTATION AND SAMPLES WERE PROCESSED IN COMPLIANCE WITH PNL TEST PROCEDURE ALO-266.
C
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ANALYST: N.L. ABBEY N.L. Abbey 10-5-93
PHONE: 376-3877

REVEIW: R.W. SANDERS R.W. Sanders 10-6-93

SS UNITS EL USGS BCR-1 B1 GREEN 1MM B2 GREEN 1MM B1 WHITE 1MM

TI

SS UNITS	EL	USGS BCR-1	+/-	EL	B1 GREEN 1MM	+/-	EL	B2 GREEN 1MM	+/-	EL	B1 WHITE 1MM	+/-
%	AL	9.20	0.71	AL	15.9	1.2	AL	17.8	2.2	AL	25.5	1.8
%	SI	28.6	2.0	SI	4.43	0.33	SI	5.01	0.64	SI	6.22	0.45
%	S	0.055	0.012	S	< 0.018		S	< 0.091		S	< 0.015	
%	CL	< 0.010		CL	0.030	0.005	CL	< 0.037		CL	0.015	0.004
%	K	1.48	0.10	K	0.130	0.011	K	0.122	0.031	K	0.242	0.018
%	CA	5.31	0.37	CA	4.23	0.30	CA	3.67	0.26	CA	2.22	0.16
%	TI	1.388	0.097	TI	0.029	0.002	TI	0.023	0.004	TI	0.033	0.002
PPM	V	421.	35.	V	34.6	5.3	V	55.	19.	V	< 6.6	
PPM	CR	< 10.		CR	1272.	90.	CR	831.	68.	CR	140.	10.
PPM	MN	1460.	110.	MN	349.	45.	MN	430.	140.	MN	46.	16.
%	FE	9.88	0.69	FE	0.499	0.035	FE	0.391	0.034	FE	0.259	0.018
PPM	NI	< 17.		NI	2500.	180.	NI	1880.	170.	NI	197.	15.
PPM	CU	48.5	7.4	CU	61900.	4300.	CU	60700.	4300.	CU	1372.	97.
PPM	ZN	130.	11.	ZN	312.	34.	ZN	182.	94.	ZN	42.3	4.5
PPM	GA	24.4	4.0	GA	395.	30.	GA	401.	54.	GA	22.1	2.4
PPM	HG	< 6.2		HG	33.6	7.1	HG	< 43.		HG	< 3.1	
PPM	SE	< 3.0		SE	< 7.4		SE	< 22.		SE	< 1.7	
PPM	PB	10.7	4.2	PB	260.	23.	PB	143.	43.	PB	46.7	4.5
PPM	AS	< 5.2		AS	33.6	8.2	AS	< 42.		AS	< 3.3	
PPM	BR	< 2.7		BR	176.	13.	BR	147.	20.	BR	20.9	1.8
PPM	U	< 5.0		U	14800.	1000.	U	12120.	850.	U	1630.	110.
PPM	SR	327.	23.	SR	225.	17.	SR	136.	17.	SR	201.	14.
PPM	Y	39.7	3.1	Y	< 7.7		Y	< 22.		Y	< 1.5	
PPM	ZR	189.	14.	ZR	13720.	960.	ZR	11740.	830.	ZR	702.	49.
PPM	NB	10.0	1.3	NB	< 21.		NB	< 75.		NB	7.1	1.6
PPM	MO	< 2.3		MO	61.	19.	MO	< 110.		MO	< 4.5	

	Unit		Value	+/-		Value	+/-		Value	+/-		Value	+/-
ZR													
	PPM	CO	< 110.		CO	< 23.		CO	< 20.		CO	< 13.	
	PPM	NI	< 28.		NI	2440.	120.	NI	2150.	110.	NI	201.	11.
	PPM	CU	20.3	4.4	CU	60900.	3000.	CU	69700.	3500.	CU	1475.	75.
	PPM	ZN	133.0	8.2	ZN	283.	22.	ZN	213.	21.	ZN	44.5	3.2
	PPM	GA	22.3	2.5	GA	324.	18.	GA	350.	20.	GA	20.5	1.6
	PPM	HG	< 7.3		HG	28.5	6.3	HG	32.5	6.7	HG	< 2.8	
	PPM	SE	< 2.3		SE	< 3.5		SE	< 3.5		SE	< 1.1	
	PPM	PB	12.1	3.0	PB	239.	14.	PB	172.	11.	PB	47.4	3.2
	PPM	AS	< 3.8		AS	21.1	4.9	AS	30.2	4.7	AS	< 2.4	
	PPM	BR	< 2.0		BR	< 4.5		BR	< 4.7		BR	< 1.2	
AG				+/-			+/-			+/-			+/-
	%	CA	4.93	0.35	CA	4.90	0.35	CA	3.46	0.24	CA	2.00	0.14
AM				+/-			+/-			+/-			+/-
	PPM	ZR	188.	14.	ZR	14900.	1000.	ZR	17900.	1300.	ZR	679.	48.
	PPM	RU	< 8.7		RU	< 44.		RU	< 48.		RU	< 9.4	
	PPM	RH	< 10.0		RH	< 40.		RH	< 42.		RH	16.7	5.5
	PPM	PD	< 11.		PD	< 36.		PD	< 39.		PD	< 10.	
	PPM	AG	< 12.		AG	168.	18.	AG	166.	19.	AG	31.5	5.9
	PPM	CD	< 14.		CD	< 28.		CD	32.	14.	CD	< 12.	
	PPM	IN	< 15.		IN	< 31.		IN	< 33.		IN	< 13.	
	PPM	SN	< 16.		SN	371.	32.	SN	449.	37.	SN	61.4	8.1
	PPM	SB	< 17.		SB	< 37.		SB	< 38.		SB	< 15.	
	PPM	TE	< 23.		TE	< 43.		TE	< 44.		TE	< 18.	
	PPM	I	< 25.		I	54.	27.	I	< 56.		I	< 22.	
	PPM	CS	< 31.		CS	< 57.		CS	< 57.		CS	< 25.	
	PPM	BA	687.	52.	BA	296.	41.	BA	272.	41.	BA	335.	28.
	PPM	LA	< 40.		LA	< 79.		LA	< 79.		LA	< 33.	
	PPM	CE	81.	25.	CE	< 100.		CE	< 110.		CE	< 39.	

SS UNITS	EL	B2 WHITE 1MM	+/-	EL	B1 WHITE 2MM	+/-	EL	B2 GREEN 2MM	+/-	EL	B1 GREEN 2MM	+/-
TI												
%	AL	29.8	2.2	AL	27.5	1.9	AL	14.8	1.1	AL	12.48	0.93
%	SI	2.75	0.23	SI	4.83	0.35	SI	6.49	0.47	SI	8.84	0.63
%	S	0.025	0.009	S	0.050	0.008	S	< 0.024		S	< 0.023	
%	CL	0.046	0.006	CL	0.031	0.004	CL	0.052	0.006	CL	0.034	0.006
%	K	0.053	0.005	K	0.072	0.006	K	0.223	0.018	K	0.327	0.024
%	CA	1.208	0.085	CA	2.44	0.17	CA	5.47	0.38	CA	5.81	0.41
%	TI	0.015	0.001	TI	0.017	0.001	TI	0.067	0.005	TI	0.099	0.007
PPM	V	< 7.1		V	< 4.4		V	64.5	7.6	V	57.8	7.7
PPM	CR	45.4	4.7	CR	34.1	3.0	CR	1690.	120.	CR	1610.	110.
PPM	MN	< 31.		MN	< 20.		MN	471.	54.	MN	408.	50.
%	FE	0.089	0.007	FE	0.180	0.013	FE	1.014	0.071	FE	1.396	0.098
PPM	NI	64.5	9.1	NI	9.1	3.1	NI	3170.	220.	NI	2490.	180.
PPM	CU	1092.	81.	CU	122.4	9.6	CU	45000.	3200.	CU	34700.	2400.
PPM	ZN	30.9	7.9	ZN	34.8	3.6	ZN	389.	33.	ZN	359.	30.
PPM	GA	20.6	4.7	GA	17.2	2.2	GA	277.	22.	GA	222.	18.
PPM	HG	< 6.9		HG	< 3.2		HG	23.6	5.8	HG	23.1	5.1
PPM	SE	< 4.4		SE	< 1.8		SE	< 6.8		SE	< 5.4	
PPM	PB	43.1	9.4	PB	32.7	3.9	PB	325.	26.	PB	298.	23.
PPM	AS	< 8.3		AS	< 3.4		AS	31.2	7.2	AS	20.9	6.3
PPM	BR	17.1	3.1	BR	12.3	1.3	BR	242.	17.	BR	182.	13.
PPM	U	1363.	96.	U	858.	60.	U	18500.	1300.	U	13570.	950.
PPM	SR	43.3	4.5	SR	68.4	5.0	SR	287.	20.	SR	297.	21.
PPM	Y	< 4.5		Y	< 1.8		Y	< 6.8		Y	< 6.0	
PPM	ZR	242.	18.	ZR	63.7	4.8	ZR	20100.	1400.	ZR	18800.	1300.
PPM	NB	< 11.		NB	< 3.5		NB	49.3	9.4	NB	20.9	7.3
PPM	MO	< 13.		MO	< 4.2		MO	38.	16.	MO	< 26.	

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C.10

ZR

			+/-			+/-			+/-			+/-
PPM	CO	< 9.9		CO	< 11.		CO	< 30.		CO	< 37.	
PPM	NI	73.1	5.4	NI	10.7	1.7	NI	3200.	160.	NI	2660.	140.
PPM	CU	1306.	67.	CU	131.1	7.5	CU	44900.	2200.	CU	37000.	1900.
PPM	ZN	47.4	4.1	ZN	32.8	2.4	ZN	389.	24.	ZN	400.	24.
PPM	GA	21.6	2.2	GA	15.1	1.4	GA	245.	14.	GA	205.	12.
PPM	HG	< 4.4		HG	< 3.2		HG	28.2	5.0	HG	20.4	4.5
PPM	SE	< 1.9		SE	< 1.4		SE	< 2.9		SE	< 2.7	
PPM	PB	44.8	4.3	PB	29.7	2.9	PB	316.	17.	PB	286.	16.
PPM	AS	< 3.7		AS	< 2.5		AS	24.3	4.6	AS	17.7	4.3
PPM	BR	< 2.2		BR	< 1.5		BR	< 3.6		BR	< 3.3	

AG

			+/-			+/-			+/-			+/-
%	CA	1.44	0.10	CA	2.34	0.17	CA	6.45	0.45	CA	6.57	0.46

AM

			+/-			+/-			+/-			+/-
PPM	ZR	303.	25.	ZR	58.1	7.4	ZR	19700.	1400.	ZR	18400.	1300.
PPM	RU	< 25.		RU	< 15.		RU	< 39.		RU	< 33.	
PPM	RH	< 27.		RH	< 17.		RH	94.	21.	RH	75.	17.
PPM	PD	< 27.		PD	< 17.		PD	< 31.		PD	< 25.	
PPM	AG	< 29.		AG	< 18.		AG	267.	22.	AG	208.	18.
PPM	CD	< 31.		CD	< 20.		CD	< 25.		CD	< 23.	
PPM	IN	< 33.		IN	< 23.		IN	< 25.		IN	< 23.	
PPM	SN	< 36.		SN	52.	13.	SN	422.	33.	SN	408.	32.
PPM	SB	< 37.		SB	< 27.		SB	< 30.		SB	< 27.	
PPM	TE	< 46.		TE	< 32.		TE	< 36.		TE	< 31.	
PPM	I	< 56.		I	< 39.		I	< 44.		I	48.	20.
PPM	CS	68.	29.	CS	< 40.		CS	< 47.		CS	< 44.	
PPM	BA	< 71.		BA	125.	25.	BA	362.	38.	BA	489.	44.
PPM	LA	< 80.		LA	< 55.		LA	< 64.		LA	< 61.	
PPM	CE	< 110.		CE	< 67.		CE	137.	44.	CE	175.	38.

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SS UNITS EL B2 WHITE 2MM BCR-1 +200PPM U

TI

SS UNITS	EL	B2 WHITE 2MM	+/-	EL	BCR-1 +200PPM U	+/-
%	AL	32.8	2.3	AL	8.61	0.60
%	SI	0.918	0.083	SI	28.8	2.0
%	S	0.012	0.005	S	0.088	0.015
%	CL	0.005	0.002	CL	< 0.013	
%	K	0.013	0.002	K	1.56	0.11
%	CA	0.166	0.012	CA	5.47	0.38
%	TI	0.00	0.00	TI	1.414	0.099
PPM	V	< 2.9		V	415.	35.
PPM	CR	24.4	2.3	CR	20.8	5.8
PPM	MN	< 16.		MN	1540.	120.
%	FE	0.035	0.003	FE	10.18	0.71
PPM	NI	15.7	3.0	NI	< 21.	
PPM	CU	271.	20.	CU	69.1	9.4
PPM	ZN	34.0	3.5	ZN	135.	12.
PPM	GA	19.5	2.2	GA	19.9	4.4
PPM	HG	< 2.9		HG	< 7.4	
PPM	SE	< 1.7		SE	< 3.4	
PPM	PB	31.1	3.8	PB	20.6	4.4
PPM	AS	< 3.1		AS	< 5.8	
PPM	BR	8.0	1.1	BR	< 2.9	
PPM	U	533.	37.	U	201.	14.
PPM	SR	21.7	1.8	SR	310.	22.
PPM	Y	< 1.7		Y	37.2	2.9
PPM	ZR	96.8	7.0	ZR	230.	16.
PPM	NB	3.0	1.4	NB	10.4	1.3
PPM	MO	< 3.6		MO	< 2.6	

9413273.0151

ZR

			+/-			+/-
PPM	CO	< 5.1		CO	< 130.	
PPM	NI	16.8	1.9	NI	27.9	5.9
PPM	CU	291.	15.	CU	30.9	4.5
PPM	ZN	31.5	2.3	ZN	135.0	8.6
PPM	GA	16.3	1.4	GA	22.5	2.8
PPM	HG	< 2.8		HG	< 7.9	
PPM	SE	< 1.3		SE	< 2.4	
PPM	PB	26.3	2.7	PB	14.9	3.2
PPM	AS	< 2.4		AS	< 4.3	
PPM	BR	< 1.4		BR	< 2.1	

AG

			+/-			+/-
%	CA	0.155	0.015	CA	5.26	0.37

AM

			+/-			+/-
PPM	ZR	99.0	9.1	ZR	137.	10.
PPM	RU	< 14.		RU	< 5.9	
PPM	RH	< 15.		RH	< 6.6	
PPM	PD	< 16.		PD	< 7.0	
PPM	AG	< 18.		AG	< 8.2	
PPM	CD	< 19.		CD	< 8.9	
PPM	IN	< 22.		IN	< 10.	
PPM	SN	< 23.		SN	< 11.	
PPM	SB	< 24.		SB	< 12.	
PPM	TE	< 30.		TE	< 15.	
PPM	I	< 36.		I	< 19.	
PPM	CS	< 38.		CS	< 21.	
PPM	BA	< 44.		BA	660.	48.
PPM	LA	< 52.		LA	< 29.	
PPM	CE	< 71.		CE	60.	20.